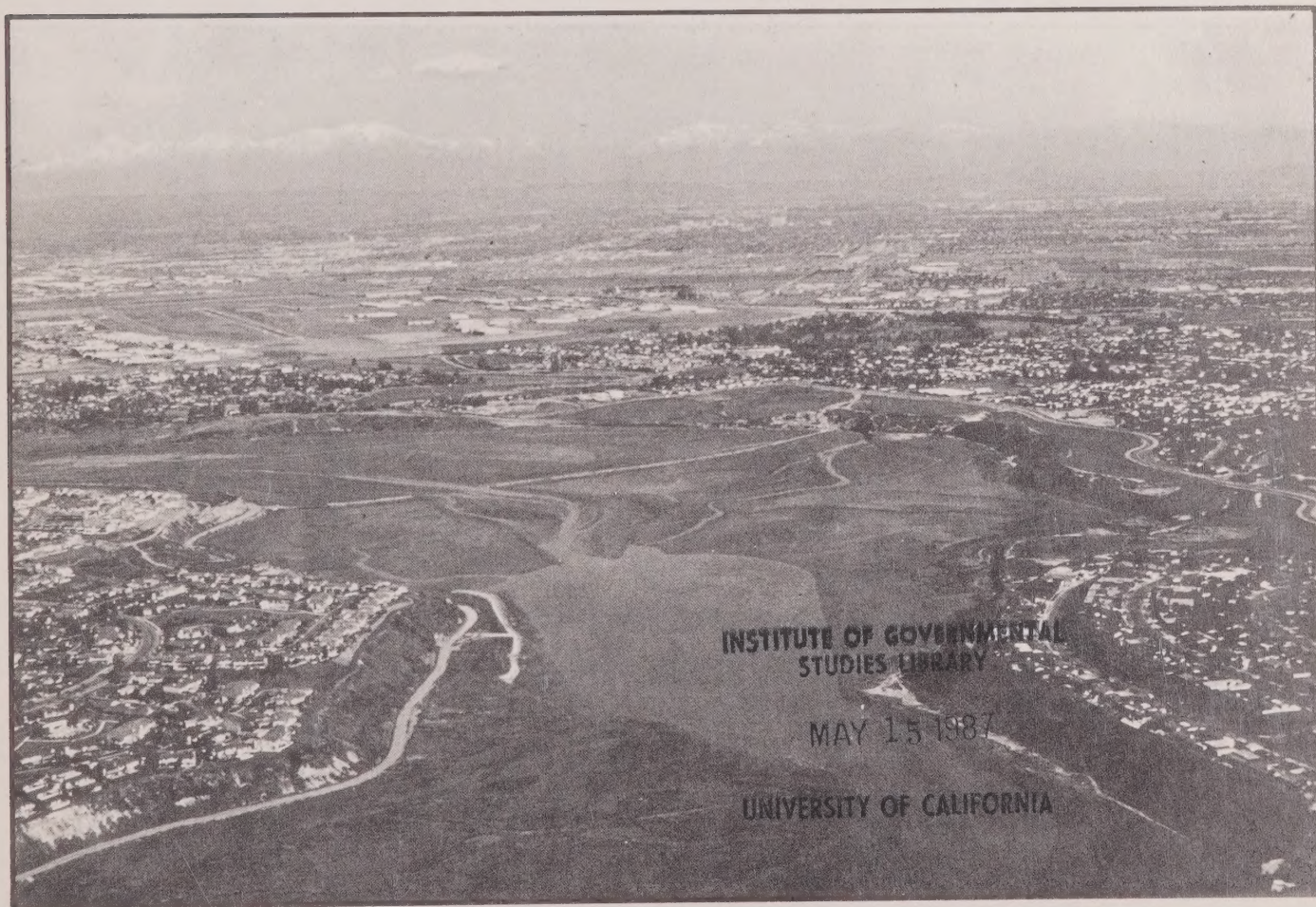


# NEWPORT BAY WATERSHED

## SAN DIEGO CREEK COMPREHENSIVE STORMWATER SEDIMENTATION CONTROL PLAN

ORANGE COUNTY  
CALIFORNIA



PREPARED FOR THE  
CITIES OF IRVINE AND NEWPORT BEACH  
AND THE  
SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

AUGUST 1983


LIBRARY  
GOVERNMENT PUBLICATIONS  
AUG 16 1990  
UNIVERSITY OF CALIFORNIA  
IRVINE



**Boyle Engineering Corporation**

consulting engineers / architects





Digitized by the Internet Archive  
in 2024

<https://archive.org/details/C124890914>

NEWPORT BAY WATERSHED  
SAN DIEGO CREEK COMPREHENSIVE  
STORMWATER SEDIMENTATION CONTROL PLAN  
ORANGE COUNTY  
CALIFORNIA

PREPARED FOR THE  
CITIES OF IRVINE AND NEWPORT BEACH  
AND THE  
SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

AUGUST 1983



# NEWPORT BAY WATERSHED

## SAN DIEGO CREEK COMPREHENSIVE

### STORMWATER SEDIMENTATION CONTROL PLAN

#### TABLE OF CONTENTS

	<u>PAGE NO.</u>
I. EXECUTIVE SUMMARY	1
II. INTRODUCTION	
A. Purpose and Authority	5
B. Scope of Study	5
C. Study Participants and Coordination	7
D. Other Studies and Reports	7
E. Definition of Terms	8
III. BACKGROUND	
A. Description of the Watershed	11
B. Geomorphology	13
C. Sediment Production and Transport	15
D. Transport, Deposition and Scour in Newport Bay	25
E. Sedimentation Effects on the Bay	29
IV. EVALUATION AND COMPARISON OF ALTERNATIVE PLANS FOR SEDIMENT CONTROL	
A. Relative Effectiveness and Costs	34
B. Environmental Assessment	62
V. RECOMMENDED PLAN	
A. Improve Agricultural Land Management Practices	66
B. Improved Construction Land Management Practices	71
C. Install In-Channel Basins	75
D. Install In-Bay Basins	76
E. Channel Stabilization	77
F. Foothill Basins	78
G. Monitoring	79
VI. PROJECT COSTS, IMPLEMENTATION AND FUNDING	
A. Estimated Costs	81
B. Schedule for Implementation	83
C. Project Funding	85
VII. ENVIRONMENTAL IMPACTS	
A. Land Management Practices	92
B. Structural Measures	92
APPENDICES	





# TABLES

<u>NO.</u>		<u>PAGE NO.</u>
1	Recommended Plan for Sediment Control - Newport Bay Watershed	3
2	Average Annual Sediment Produced from Upslope Areas for Existing Conditions	17
3	Average Annual Sediment Produced from Upslope Areas for Ultimate Conditions	18
4	Average Annual Sediment Production and Deposition - San Diego Creek Watershed - Existing and Ultimate Conditions	23
5	Average Annual Sediment Production and Deposition, San Diego Creek Watershed (Existing Conditions)	35
6	Average Annual Sediment Production and Deposition Assuming All Channels Stabilized (Existing Conditions)	38
7	Average Annual Sediment Production and Deposition Assuming All Channels Stabilized (Ultimate Conditions)	39
8	Average Annual Sediment Production and Deposition with In-Channel Basins No. 2 and 3 Installed - Early Action and Interim Plan (Existing Conditions)	46
9	Average Annual Sediment Production and Deposition with Basins No. 2, 3, 4, 5, and 6 Installed, Alternative No. 4 (Existing Conditions)	49
10	Average Annual Sediment Production and Deposition with Installation of 12 Foothill Basins, Alternative No. 5 (Existing Conditions)	55
11	Average Annual Sediment Production and Deposition, Combined Installation of Alternative 4 and 5 (Existing Conditions)	56
12	Summary of Deposition Characteristics and Costs, Alternative Sedimentation Control Systems (Existing Conditions)	59
13	Estimated Project Costs	82





## FIGURES

<u>NO.</u>		<u>PAGE NO.</u>
1	San Diego Creek Watershed	12
2	Sediment Production - Terrain Type - Existing Conditions	19
3	Sediment Production Rates - Existing Conditions	20
4	Average Annual Sediment Production in Newport Bay Watershed for Existing Conditions	24
5	Particle Size Distribution - Sediment Inflow to Bay	26
6	Estimated Sediment Inflow to Upper Newport Bay - Storms of Various Return Periods	27
7	Sediment Deposition - Upper Newport Bay (1968-1977)	30
8	Average Annual Sediment Production in Newport Bay Watershed for Ultimate Conditions	40
9	San Diego Creek Watershed - Downstream Projects	42
10	Typical Excavated Sections, In-Channel Sedimentation Basins	44
11	San Diego Creek Watershed, In-Channel Basin Structures	45
12	San Diego Creek Watershed, Foothill Sedimentation Basins	52

The preparation of this report was financed in part through Planning Grant No. P009325-01 from the United States Environmental Protection Agency, under the provisions of Section 208 of the Federal Water Pollution Control Act of 1972, as amended.



## I. EXECUTIVE SUMMARY

The Upper Newport Bay Ecological Reserve is a 741-acre state reserve owned and managed by the California Department of Fish and Game. In recent years, the amount of sediment deposited in the Reserve from the San Diego Creek Watershed has increased greatly, largely due to improved channels which transport the sediment load into the Bay instead of depositing it in ponded areas that existed prior to channel improvements. This accelerated rate of deposition in the Upper Bay has caused concern that unless effective actions are taken to reduce the inflow of sediment it will be very difficult to achieve the objectives of protecting and enhancing the Ecological Reserve.

The cities of Newport Beach and Irvine entered into a cooperative agreement with the Southern California Association of Governments to use 208 Water Quality Planning funds for a two and a half year study to develop a comprehensive stormwater sedimentation control plan for the San Diego Creek Watershed. The two cities contracted with Boyle Engineering to prepare the plan, which is divided into four parts:

- Part I: Early Action and Interim Plan
- Part II: Sedimentation Analysis
- Part III: Comprehensive Stormflow Sedimentation Control Plan, Engineering
- Part IV: Comprehensive Stormflow Sedimentation Control Plan, Environmental

The Early Action Plan has been implemented. It includes two in-channel sedimentation basins in San Diego Creek upstream of MacArthur Boulevard and an excavated basin in Upper Newport Bay below Jamboree Road. Concurrent with preparation of this plan, two separate studies were conducted on improving land management practices for agricultural land and construction sites in the San Diego Creek Watershed.

The results of the sedimentation analysis indicate that with completion of the Early Action and Interim Plan, the average annual inflow of sediment to the Bay has been reduced from approximately 85,000 tons to 60,000 tons. Open space and agricultural land uses produce most of the sediment in the Watershed, with construction sites contributing about 15 percent, and urbanized lands approximately two percent.

Ultimately, increased urbanization will result in a substantial reduction in upslope sediment production. However, it will cause increased amounts of runoff and higher peak flows. Consequently, if channel improvement measures are not coordinated with urban development, there will be more channel erosion in unstabilized channels and increased amounts of sediment transported through the drainage system. The effectiveness of the in-channel sedimentation basins would be reduced because of this increased amount of sediment.



The recommended plan consists of land management practices to reduce sediment at its sources and structural measures to localize sediment deposition and facilitate its management. Whereas some recommendations in the plan can be implemented in the near term, such as improved land management practices and downstream sedimentation facilities, other plan components, such as channel stabilization, will be implemented over a longer time frame. Implementation will be accomplished through the local regulatory process and through cooperative agreements entered into by the implementing parties. The recommended plan is summarized on Table 1.

A program environmental impact report (EIR) which addresses the environmental impacts associated with approval and implementation of the proposed plan has been prepared and is available for review. While the EIR finds that, in the long-run, the proposed plan elements will be beneficial to Upper Newport Bay, it also notes that the proposed structural measures will have adverse environmental impacts during the initial construction and periodic maintenance periods. The EIR recommends measures which could mitigate many of these adverse effects.

TABLE 1  
RECOMMENDED PLAN FOR SEDIMENT CONTROL  
NEWPORT BAY WATERSHED

<u>Plan Element</u>	<u>Implementor</u>	<u>Schedule</u>
1. Improve agricultural land management practices.	Orange County City of Irvine City of Newport Beach Landowners	High Erosion hazard areas - 1984 Remaining areas - 1985
2. Improve construction land management practices	Orange County City of Newport Beach City of Irvine Developers	1984 and Continuing (see pg. 83 )
3. Install three additional in-channel basins	Orange County City of Newport Beach City of Irvine Landowners	1988
4. Install in-bay basins	State Dept. of Fish & Game City of Newport Beach City of Irvine County of Orange Orange County Dept. of Harbors, Beaches and Parks Landowners	1988
5. Stabilize channels within developing areas and dedicated rights-of-way	Developers City of Irvine Orange County Flood Control District	Within undeveloped areas: concurrent with development. Within dedicated rights-of-way: 1984
6. Install foothill basins	Beneficiaries of reduced-cost downstream flood control facilities (developers and local jurisdictions)	Concurrent with construction of downstream drainage facilities

(Table Cont'd Next Page)

Table 1 (Cont'd)

<u>Plan Element</u>	<u>Implementor</u>	<u>Schedule</u>
7. Monitor sediment delivery to Newport Bay and transport through the Bay	County of Orange City of Irvine City of Newport Beach State Dept. of Fish & Game The Irvine Company	Begin 1983 continue for a minimum of 10 years



## II. INTRODUCTION

### A. Purpose and Authority

Large amounts of sediment have deposited in Upper Newport Bay in recent years adversely affecting the Upper Newport Bay State Ecological Reserve. It is considered urgent that effective actions be taken to reduce the inflow of sediment to the Bay so that the ecological reserve may be effective in realizing its objectives.

The Upper Newport Bay Ecological Reserve is a 741-acre state reserve owned and managed by the California Department of Fish and Game. This combination of lands and tidal marshes is a part of the system of ecological reserves in California. The Department of Fish and Game has a program of rehabilitating portions of the reserve to increase a diversity of habitat that will benefit marine aquatic organisms and other wildlife that are dependent upon tidal marshlands for their continued existence. Also included are provisions for construction of public use facilities that will be used for aesthetic, educational and scientific purposes.

In order to provide a basis for effective actions toward reducing the inflow of sediment into the Bay, the cities of Newport Beach and Irvine have entered into a cooperative agreement with the Southern California Association of Governments to study this problem and determine solutions. Funding for this study is provided in part through a grant from the United States Environmental Protection Agency.

The cities of Newport Beach and Irvine entered into an agreement with Boyle Engineering Corporation to conduct studies to achieve three objectives:

1. To develop an early action and interim sedimentation control plan for Upper Newport Bay and San Diego Creek and its tributaries which can be approved for implementation in December 1980 and implemented in the ensuing months of 1981 prior to the onset of the 1981/82 rainy season.
2. To analyze and characterize the causes, nature and extent of the sedimentation problems adversely affecting Upper Newport Bay.
3. To develop a comprehensive watershed erosion and stormflow sediment control plan, with emphasis on a downstream desilting system along San Diego Creek that can be implemented in the near-term.

### B. Scope of Study

The study identified as "The Newport Bay Watershed: San Diego Creek Comprehensive Stormwater Sedimentation Control Plan" is divided into four parts:

- Part I: Early Action and Interim Control Plan
- Part II: Sedimentation Analysis
- Part III: Comprehensive Stormflow Sedimentation Control Plan,  
Engineering
- Part IV: Comprehensive Stormflow Sedimentation Control Plan,  
Environmental

Part I: Early Action and Interim Control Plan, was completed and control measures were recommended for early installation, which include two in-channel sedimentation basins on San Diego Creek immediately upstream from MacArthur Boulevard and an excavated basin in Upper Newport Bay immediately downstream of Jamboree Road. These measures have been installed and were in operation during the 1982/83 rainy season.

Part II: Sedimentation Analysis, is divided into five tasks for developing the information required and includes a sixth task to summarize the results obtained:

- Task II-A: Hydrologic Analysis
- Task II-B: Geomorphic Analysis
- Task II-C: Sediment Source Analysis
- Task II-D: Sediment Delivery Analysis
- Task II-E: Sediment Transport, Deposition and Scour in Newport Bay
- Task II-F: General Audience Report (Summary of Part II determinations)

Part III: Comprehensive Stormflow Sedimentation Control Plan, Engineering, is divided into nine tasks:

- Task III-A: Development and Preliminary Analysis of Alternatives
- Task III-B: Selection of Alternative Management Systems
- Task III-C: Comparison of Alternative Management Systems
- Task III-D: Technical Review and Refinement
- Task III-E: Report on Plan Alternatives
- Task III-F: Public Review of Alternatives
- Task III-G: Review Written Comments and Prepare Responsiveness Document
- Task III-H: Prepare Recommended Plan and Preliminary Draft Program EIR
- Task III-I: Assist in Securing Implementation Commitments

Part IV: Comprehensive Stormflow Sedimentation Control Plan, Environmental.

This "Newport Bay Watershed: San Diego Creek Comprehensive Stormwater Sedimentation Control Plan" presents the recommended plan, based on the technical investigations and analyses, for controlling the sediment inflow to Upper Newport Bay.

The draft Comprehensive Stormflow Sedimentation Control Plan, Environmental, is being issued as a separate document.

### C. Study Participants and Coordination

Prior to the development of an Early Action and Interim Control Plan, a committee chaired by 5th District Orange County Supervisor Tom Riley met on a monthly basis to discuss alternative measures that might be used. This committee was composed of representatives from Orange County, the cities of Irvine and Newport Beach, The Irvine Company, California Department of Fish and Game, Regional Water Quality Control Board, and others along with representatives from Boyle Engineering Corporation.

Alternative measures that had been considered in previous studies or were suggested by committee members were reviewed. Boyle Engineering Corporation presented their proposed plan for the Early Action and Interim Plan which was prepared with consideration of the information developed by this committee. The committee agreed to the concept presented by Boyle Engineering Corporation.

Several public meetings were conducted in the area to present the proposed plan and to obtain further citizen input on problems and to discuss alternatives.

The final plan for the Early Action and Interim Plan was presented to the City Council of Newport Beach and they approved the plan for implementation.

Technical memoranda were prepared for each of the tasks included in Parts II and III requiring technical investigations and analyses. General Audience Reports were prepared for Task II-F (Summary of Tasks II-A to E) and Task III-E (Summary of Tasks III-A to D). These documents were reviewed by the clients, the State/Federal Oversight Committee members, and others.

The State/Federal Oversight Committee was composed of representatives from the State Water Resources Control Board, Santa Ana Regional Water Quality Control Board, State Department of Fish and Game and United States Environmental Protection Agency. The Committee met periodically during the study period to review and comment on draft reports for the various Tasks; review and approve schedules; and determine compliance with the approved work plan.

### D. Other Studies and Reports

Two other studies were completed and closely coordinated with the development of this plan.

Sediment control plans for agricultural areas and construction sites in the Newport Bay Watershed have been developed in technical memoranda for Task 8105.01 (Agricultural Activities Interim Sedimentation Control Plan) and Task 8015.03 (Construction Activities Best Management Practices Plan for Sediment Control).



The report on the Newport Bay Watershed: Agricultural Activities Interim Sedimentation Control Plan was prepared by the Orange County Environmental Management Agency (OCEMA), dated March 1981.

The report on the Newport Bay Watershed: Construction Activities Best Management Practices for Sediment Control was prepared for the City of Irvine by Boyle Engineering Corporation, dated November 1981.

These studies provide guidance for the development of plans to control sediment production from agricultural and construction areas.

#### E. Definition of Terms

Antecedent Moisture Condition: The degree of wetness of a watershed at the beginning of a storm.

Armored Layer: Layer of cobbles and larger-sized particles on stream bottom reducing susceptibility to channel erosion.

Bed Load: Sediment that moves by saltation (jumping), rolling or sliding in the bed layer.

Bed Material: The sediment mixture of which the streambed is composed.

Channel Stabilization: Erosion prevention and stabilization of velocity distribution in a channel by use of impervious linings, drops, revetments, vegetation and other measures.

Contour Line: A line joining points having or representing equal elevations.

Discharge (flow): The rate at which water (or more broadly, total fluids, plus suspended sediment) passes a given point, expressed in volume per unit time (e.g., cubic feet per second, or c.f.s.).

Drainage Area: The area that contributes runoff to a stream at a specified location (concentration point).

Erodible: Susceptible to erosion.

Erosion: Detachment and movement of the solid material from the land surface by wind, water and ice or by gravity as in landslides. In this report, erosion is related to movement by water only.

Floodwater Retarding Structure: Dam across a water course usually designed with an uncontrolled outlet for the temporary storage of runoff.

Gaging Station: A particular site on a stream, canal, lake or reservoir where systematic observations of gage height or discharge are obtained.

**Gully Erosion:** Erosion that causes elongated depressions in the land surface through which water commonly flows only during and immediately after heavy rains.

**Hydrograph:** Graphical or tabular representation of flow rate with respect to time.

**Hydrology:** Science dealing with the properties, distribution and flow of water on or in the earth.

**Hydrometer Analysis:** Determination of particle size distribution of the finer sediment particles (silt and clay) on the basis of settling velocities.

**MSL:** Mean sea level datum.

**MLLW:** Mean Lower Low Water datum - this is 2.56 feet below Mean Sea Level datum.

**Particle Size:** Diameter in millimeters (mm) of a sediment grain determined by either sieve or sedimentation methods.

**Reach:** A comparatively short length of a stream or channel.

**Return Period:** The average number of years within which a given event will be equaled or exceeded. A 50-year frequency flood has a 50-year return period, and so on.

**Rill Erosion:** Erosion causing formation of shallow channels that can be smoothed out by normal cultivation.

**Runoff:** The portion of precipitation which is returned to the stream as surface flow.

**Sediment:** Solid material that is derived mostly from disintegrated rocks and is transformed by, suspended in, or deposited from water.

**Sediment Load:** Amount of sediment carried by running water.

**Sedimentation:** Deposition of waterborne sediments due to a decrease in velocity and a corresponding reduction in the size and amount of sediment which can be carried.

**Sedimentation Basin:** Basin or pond at the upper end of a channel or reservoir to store sediment-laden water for a sufficient length of time for the sediment to be deposited.

**Sheet Erosion:** Removal of a fairly uniform layer of soil or material from the land surface by runoff water.

**Sieve Analysis:** Determination of particle size distribution of the coarser sediment particles by passing through sieves of various size openings.

Stream Bank Erosion: Scouring of material and the cutting of channel banks by running water.

Streambed Erosion: Scouring of material and cutting of channel beds by running water.

Stream Gradient: The general slope or rate of change in vertical elevation per unit of horizontal distance of the water surface of a flowing stream.

Suspended Load: Material moving in suspension in a fluid being kept up by the upward components of the turbulent currents or by colloidal suspension.

Time of Concentration: Time required for water to flow from the most remote point of a watershed, in a hydraulic sense, to the outlet.

Wash Load: That part of the sediment load of a stream which is composed of particle sizes smaller than those found in the shifting portions of the streambed.

Watershed: Total land area above a given point on a stream or waterway that contributes runoff to that point.



### III. BACKGROUND

#### A. Description of the Watershed

The San Diego Creek watershed, from which the runoff discharges into Upper Newport Bay, has a drainage area of about 118 square miles (75,500 acres). The total drainage area into Newport Bay is about 154 square miles (98,500 acres). This includes the Santa Ana-Delhi Channel and other areas which drain directly into the bay. There are three different geographical areas within the watershed: the rugged foothills, the flat alluvial Tustin Plain, and the Coastal Plain (Figure 1).

The foothill areas have slopes ranging from 15 to 75 percent and an average annual rainfall of about 17 inches. The predominant land uses are for cattle grazing and wildlife areas. On the less-steep slopes there are citrus and avocado orchards. They include the major erosion hazard areas in the watershed because of the steep slopes, higher rainfall intensities, and soil and cover characteristics. Severe sheet erosion occurs in areas having limited cover protection and erosive actions occur in unstable channel sections.

The alluvial plain has slopes ranging from 0 to 15 percent and average annual rainfall of about 13 inches. The predominant land use is for high-value agricultural production including citrus fruits, avocados, truck crops, grain, and nurseries. The soils in this area are generally very erosive, and require good land management practices to control erosion. The eroded material from these areas is composed predominantly of the finer particles which are difficult to trap and tend to continue through the watershed to Upper Newport Bay.

The Coastal Plain also has the flatter slopes and average annual precipitation of about 13 inches. This area is largely urbanized with minimal erosion.

San Diego Creek has two major tributaries of about equal size. Peters Canyon Wash includes Peters Canyon, Rattlesnake Canyon and Hicks Canyon Washes which have their headwaters in the foothills of the Santa Ana Mountains. Elevations range from about 40 feet at its junction with San Diego Creek to a peak above Hicks Canyon with an elevation of 1775 feet. Stream gradients range from 320 feet per mile in Hicks Canyon to Less than 10 feet per mile along Peters Canyon Wash near its junction with San Diego Creek. The valley is a flat alluvial plain with an average slope of 2 percent. The existing channels are well defined and have been improved somewhat for agricultural drainage. These channels have been located for the convenience of agriculture and do not always follow the natural drainage pattern of the land. As a result, when the channels reach their capacities, excess flows will break away from the channels and sheet flow across the alluvial plain. The total drainage area of Peters Canyon Wash above its junction with San Diego Creek is about 44 square miles.

Above its junction with Peters Canyon Wash, San Diego Creek extends in an easterly direction to include Bee Canyon, Round Canyon, Agua Chinon



12

FIGURE  
1

# SAN DIEGO CREEK WATERSHED

Wash, Borrego Canyon Wash and Serrano Creek, all of which have their headwaters in the Santiago Hills. The streams from these headwater areas flow southwestward across an alluvial plain into San Diego Creek. Elevations range from about 40 feet at its junction with Peters Canyon Wash to a peak above Round Canyon with an elevation of 1770 feet. Stream gradients range from 140 feet per mile in Bee Canyon to About 30 feet per mile immediately above its junction with Peters Canyon Wash. The valley, including the U. S. Marine Base, is an alluvial plain with an average slope of two percent.

The existing channels are well defined and have been improved somewhat for agricultural drainage. As on Peters Canyon Wash, they have been located for the convenience of agriculture and do not always follow the natural drainage pattern of the land. When these channels reach their capacities, excess flows will overtop the channels and sheet flow across the alluvial plain. The total drainage area of San Diego Creek above its junction with Peters Canyon Wash is about 46 square miles.

The channel gradient on San Diego Creek downstream from the San Diego Freeway is quite flat ( $S=0.0009$  foot/foot, approximately).

The San Diego Creek watershed is rapidly changing from agricultural use to urban development. The major areas of urban development are on the westerly portion of the watershed, primarily in the Peters Canyon Wash drainage area. It is anticipated that within the next 30 to 40 years the lands will be entirely in urban uses except for the rugged foothill areas.

The Santa Ana-Delhi Channel drains an area of about 18 square miles adjacent to the western edge of the San Diego Creek watershed. This channel discharges directly into Upper Newport Bay. The area is almost totally urbanized. Other small drainage areas discharge directly into Newport Bay.

## B. Geomorphology

The technical memorandum for the Geomorphic Analysis (Task II-B) titled "Geomorphology of The San Diego Creek-Newport Bay Area", was prepared by Stanley W. Trimble, Department of Geography, University of California, Los Angeles.

This memorandum describes the physiography, geology and soils characteristics of the study area. It also describes the geologic and cultural changes that have occurred which have affected the drainage pattern of the watershed into Upper Newport Bay; and the production and transport of sediment within the watershed.

Over geologic time, the Santa Ana River has meandered across the Los Angeles alluvial plain and in middle Pleistocene times the river had cut a channel around the north end of Newport mesa and out through the current Newport Bay trough. Sea level was considerably lower at that time. A rise in the sea level followed with the sea extending 7-10 miles inland. Newport Mesa initially remained as a low island



but was later inundated. As the area emerged from the sea near the end of the Pleistocene epoch, the Santa Ana River returned to the Newport Bay trough and scoured at least part of the marine sediments accumulated during the inundation.

During the following few thousand years, the river may have intermittently reentered the bay because a series of marine and estuarine deposits filled the trough floor. This may explain the presence of fine silts and clays at greater depths in the upper end of the bay.

An alternative hypothesis is that the Santa Ana River shifted to somewhere near its present location, formed a barrier island blocking the bay similar to the present Balboa Peninsula, allowing sediment from local erosion to be deposited in an estuarine environment, as was the case from about 1860 to quite recently. Such a low-energy environment and the presence of salt water to promote flocculation would probably require such a period of time for sediment to accumulate.

These and other hypotheses related to the Santa Ana River and geologic changes are factors to be considered in understanding the profiles of sediment deposited in Newport Bay.

San Diego Creek did not have integrated drainage nor regular drainage to the sea at the time of the European settlement. Sediment-laden streams flowed through the steep valleys to the Tustin Plain where the slope suddenly decreased. The resulting decrease in velocities and the lateral spreading of the flows caused rapid infiltration and the deposition of coarser sediment, creating alluvial fans at the base of the hills. The deposited coarse sediments allowed rapid infiltration and it is doubtful that most flows continued across the Tustin Plain to the southeast. It appears that the only channel extending across much of the Tustin Plain was the San Diego Creek proper, but few of its tributaries were included.

Even when streamflow did travel across the Tustin Plain, it rarely flowed into the sea. Drainage into Upper Newport Bay was apparently blocked by a narrow ridge at the head of the trough. Exceptional storm flow from the San Diego Creek basin was ponded in an ephemeral lake located between Upper Newport Bay and the present site of Santa Ana. The ephemeral lakebed and the area north and east was usually swampy and marshy and was known as the "Swamp of the Frogs."

These wet areas, as well as the remainder of the Tustin Plain, were later drained by ditches. These ditches were expanded to integrate the drainage of San Diego Creek and all was artificially channeled into Upper Newport Bay.

Two important and related geomorphic problems emerge. 1) The pre-settlement Tustin Plain was adjusted to non-channeled influent streams with a base level of over 30 feet above sea level. A new base level of sea level was imposed and the streams were artificially channeled so that important erosional adjustments had to take place so long as the stream channels were erodible. This process continues at present and will continue until an equilibrium slope has been attained. 2) A



sediment sink, the Tustin Plain, has been converted into a sediment source.

Changes in land use over historical times have accelerated the processes of erosion and sediment transport. The lands in the study area were parts of three Spanish ranches and used primarily for cattle grazing. More extensive commercial agriculture became important after 1900 and extensive drainage and irrigation development began.

Land use in the watershed has become progressively more intensive in the years since 1930. This more intensive use relates to agricultural use as well as urban use.

When the natural cover in the watershed is removed for agricultural purposes, especially for clean-cultivated crops, the land becomes more susceptible to sheet and rill erosion. With the provision of drainage ditches, both local and trunk, this eroded material is more efficiently transported through the watershed and sedimentation tends to occur in the lower reaches of the watershed rather than locally. The delivery of sediment into Upper Newport Bay was undoubtedly greatly increased with the improved channelization of the outlet of San Diego Creek into the Bay in the 1960's.

When urban development occurs there is a limited period during the construction phase when the land is highly susceptible to erosion. However, when these urban developments mature with paved surfaces, landscaping and stabilized channels, upslope sediment production is greatly reduced as compared with natural conditions. However, it will cause increased amounts of runoff and higher peak flows. Consequently, if channel improvement measures are not coordinated with urban development, there will be more channel erosion in unstabilized channels and increased amounts of sediment transported through the drainage system. The effectiveness of the in-channel sedimentation basins would be reduced because of this increased amount of sediment.

### C. Sediment Production and Transport

The Technical Memorandum for Part II, Tasks II-C and II-D, provides detailed information on the Sediment Source Analysis and the Sediment Delivery Analysis.

In the development of sediment production estimates the watershed was divided into 83 subdrainage areas. Sediment production was estimated for each of these subdrainage areas using a modified version of the Universal Soil Loss Equation (U.S.L.E.). Appropriate parameters for each of the subdrainage areas for use in the U.S.L.E. were estimated. Error in the estimates for individual subdrainage areas could be in the range of 0.5 to 2.0, or more, when they could not be verified with the field data available, such as stream or reservoir sediment data. This also applies to particle size distributions of sediment produced, because soil samples used in the analysis may not represent each sub-basin accurately.

However, the range of error is reduced when larger areas of the watershed are considered. Results obtained for groups of subbasins which drain into the three U.S.G.S. gaging stations compared well with U.S.G.S. data. The estimates for the entire watershed are therefore considered to be within a reasonable level of accuracy.

Sediment yield from a watershed is the result of the interaction of two considerations. The first consideration is the supply of sediment originating from upslope areas which enters the stream system. This includes sediment contributed by sheet and rill erosion, gully erosion and landslides. The second consideration is the transport of sediment through the stream system. The fine sediment is usually transported by the stream without much deposition. In contrast, the transport of coarser sediment is dependent on the transport capacity of flows in the channels.

Sediment production in the watershed was estimated on the basis of five land use categories: agriculture, open space, urban, rural (low-density residential development), and construction areas.

At present, (1979-80 data) the approximate percentages of the watershed in various land use categories are:

Agriculture	-	23 percent
Urban	-	47 percent
Open Space	-	28 percent
Construction	-	2 percent
	---	
	100	

Under anticipated ultimate conditions, these percentages were estimated as:

Urban	-	81 percent
Rural	-	8 percent
Open Space	-	11 percent
	---	
	100	

No land was assumed to be in agriculture. However, the City of Irvine General Plan indicates an area of about 4,000 acres in permanent agriculture. This reservation was prompted by the noise problem related to the El Toro Marine Base. On the basis that changed conditions in the future may cause changed attitudes as to the need for this agricultural reserve, the analysis for sediment production and delivery assumes that it will eventually be in urban use.

Average annual sediment production in foothill and valley areas of the watershed is summarized in Tables 2(existing conditions) and 3 (ultimate conditions.) Sediment production for each land use within these areas is listed along with totals for the two areas. Figure 2 illustrates the sediment production-terrain type relationships in the watershed under existing conditions. Figure 3 illustrates the sediment production rates for the various land uses.

TABLE 2  
AVERAGE ANNUAL SEDIMENT  
PRODUCED FROM UPSLOPE AREAS  
FOR  
EXISTING CONDITIONS

Land Use	Foothill Area			Valley Area			Total		
	Area Sq. Mi.	Sediment Production Tons/Sq. Mi.	1000 Tons	Area Sq. Mi.	Sediment Production Tons/Sq. Mi.	1000 Tons	Area Sq. Mi.	Sediment Production Tons/Sq. Mi.	1000 Tons
Open Space	28.8	1,800	52.6	13.3	290	3.9	42.1	1,300	56.5
Agricultural	8.6	3,500	30.1	25.0	980	24.5	33.6	1,600	54.6
Urban	3.5	220	0.8	66.7	40	2.6	70.2	50	3.3
Construction	.5	9,200	4.6	2.5	6,000	14.9	3.0	6,500	19.5
TOTAL	41.4	2,100 <sup>1/</sup>	88.0	107.4	430 <sup>1/</sup>	45.9	148.9	900 <sup>1/</sup>	133.9

<sup>1/</sup> Weighted average of production rates for areas.

TABLE 3  
AVERAGE ANNUAL SEDIMENT  
PRODUCED FROM UPSLOPE AREAS  
FOR <sup>1/</sup>  
ULTIMATE CONDITIONS

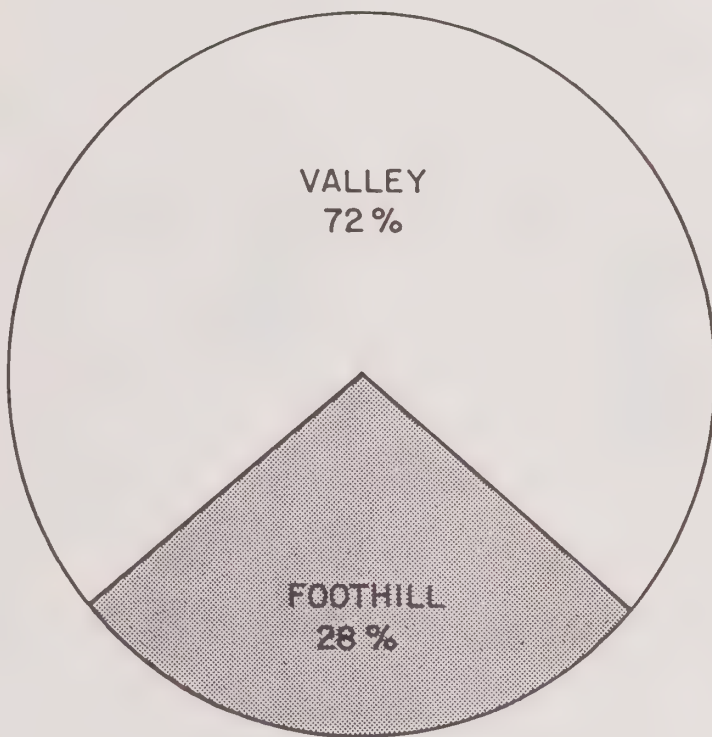
Land Use	Foothill Area			Valley Area			Total		
	Area Sq. Mi.	Sediment Production		Area Sq. Mi.	Sediment Production		Area Sq. Mi.	Sediment Production	
		Tons/Sq. Mi.	1000 Tons		Tons/Sq. Mi.	1000 Tons		Tons/Sq. Mi.	1000 Tons
Open Space	9.2	3,100	28.8	6.5	400	2.6	15.7	2,000	31.3
Urban	20.5	460	9.4	100.2	60	5.9	120.7	130	15.2
Rural <sup>2/</sup>	11.7	2,000	23.8	0.8	380	0.3	12.6	1,900	24.1
TOTAL	41.4	1,500 <sup>3/</sup>	61.9	107.5	80 <sup>3/</sup>	8.8	148.9	480 <sup>3/</sup>	70.7

<sup>1/</sup> Under conditions of ultimate development with 4,000 acres of land remaining in an agricultural preserve as specified on the City of Irvine General Plan, the average annual sediment production would be about 5,800 tons larger than the amount indicated above, for a total of 76,500 tons.

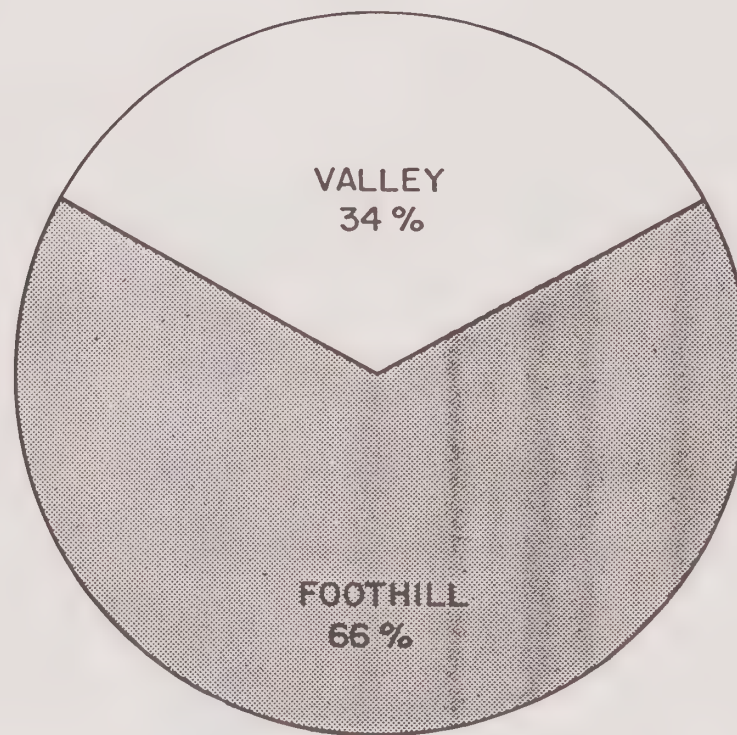
<sup>2/</sup> Low-density residential development.

<sup>3/</sup> Weighted average of production rates for areas.

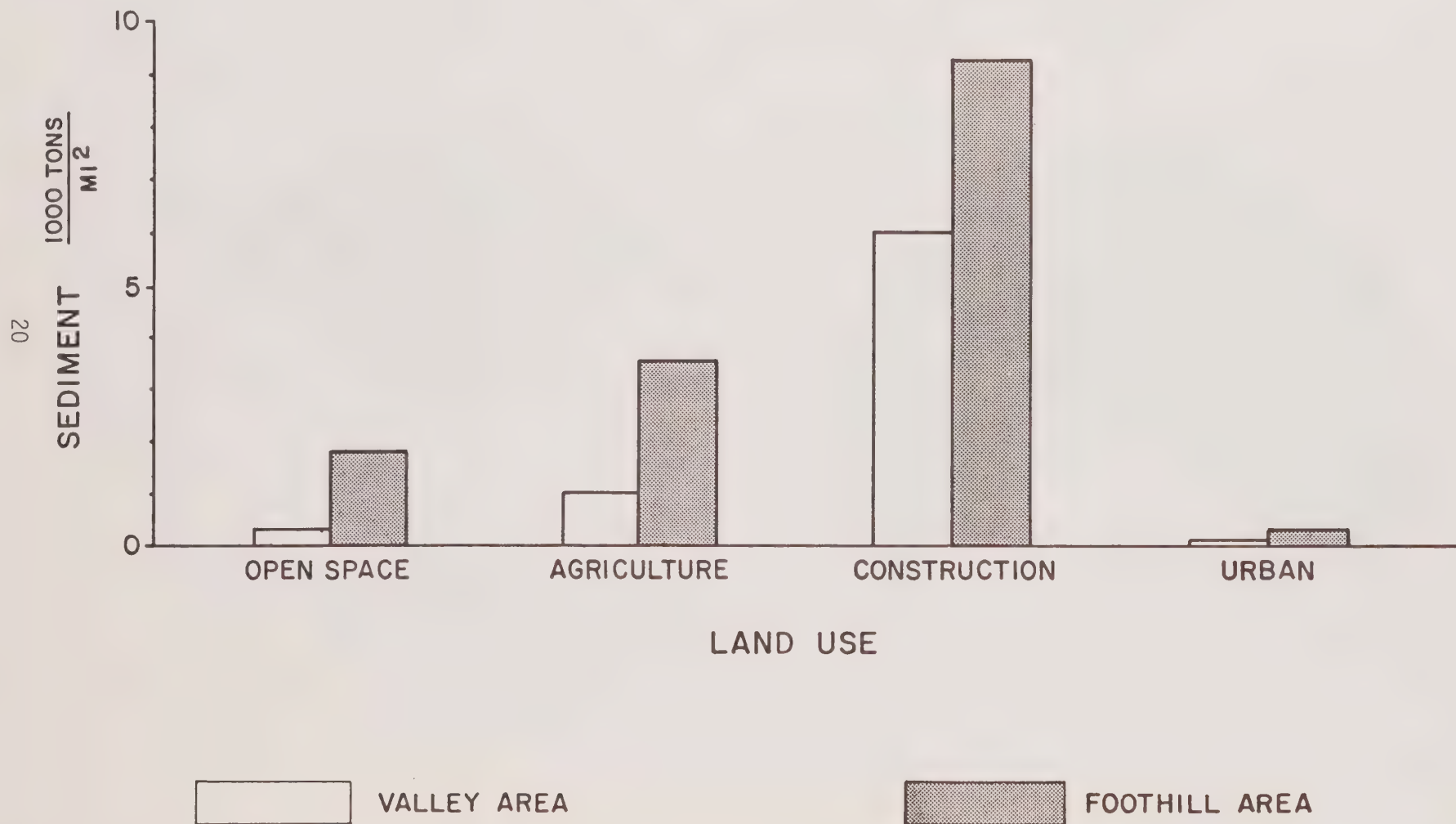




PERCENT  
DRAINAGE  
AREA



PERCENT  
SEDIMENT  
PRODUCTION



**SEDIMENT PRODUCTION - RATES  
EXISTING CONDITIONS**



**Boyle Engineering Corporation**  
consulting engineers / architects

The following conclusions are evident from these results:

1. Significantly greater quantities of sediment are produced in foothill areas. This is largely due to the relatively steep slopes in these areas.
2. Construction areas have the highest sediment production rate, followed by agricultural, open space, and urban areas.
3. Total sediment production under existing conditions appears to indicate that open space and agricultural areas produce similar quantities of sediment. However, this is only because more of the open space areas are in the steeper foothills.
4. The average rate of sediment production from urban areas is higher under ultimate conditions. This is because in the future more urban development will occur in the foothills.
5. Total sediment production for the basin as a whole is less under ultimate conditions. This is because construction and agriculture, both high sediment-producing land uses, were assumed to be eliminated under ultimate conditions.

The total sediment load in a stream is the sum of bed material load and wash load. The bed material load is that part of the total sediment discharge which is composed of grain sizes found in the bed. The wash load is that part composed of particle sizes finer than those found in appreciable quantities in the bed. In this study, wash load was estimated to contain particle sizes less than 0.0625 mm (silt and clay).

Wash load can be transported easily in large quantities by the stream, and availability usually limits the quantity of fines in a stream rather than transport capacity. Fine material transported as wash load can originate in upslope areas and stream banks. The material eroded from channel sections by downcutting is generally composed of coarse and fine sands, with relatively small amounts of silt and clay. The material in the channel banks includes relatively high percentages of silt and clay, ranging from 18 to 55 percent.

Field inspection has indicated that bankcutting is not widespread in the stream reaches of the watershed. In this study it was assumed that there is negligible sediment production by bank cutting and it is not included as a source of sediment production. There is undoubtedly some sediment production by bankcutting and there are some contentions that it is a major source of sediment. Estimation of the average annual amounts of sediment produced by bankcutting requires periodic surveys or examinations of channel width changes from existing large scale maps or aerial photographs. Such information is not available for channels within the watershed. The U.S.G.S. and County of Orange are jointly funding a study to attempt to obtain more data on channel erosion.



However, to the extent that bankcutting occurs, additional sediment from channel erosion will enter the stream system including a higher percentage of silt and clay particles than is included in the material eroded by downcutting.

The estimates of average annual sediment transported through the drainage system coordinated well with U.S.G.S. data. A reallocation of sediment production to different sources, such as channel erosion, would not affect the recommended downstream sediment control measures as they are planned on the basis of the estimated total average annual amounts of sediment transported to the downstream channel reaches.

If there is a significant amount of sediment produced by bankcutting it would indicate that there is less sediment produced by upslope areas. The sediment produced by upslope areas is estimated to be composed of 68 percent silt and clay particles and 32 percent sand particles. The additional sediment produced by bankcutting would generally have a lower percentage of silt and clay particles and the percentage of silt and clay particles in the stormflows would tend to be reduced. However, this change in composition would not be sufficient to cause a significant change in the deposition characteristics of the total sediment load.

Wash load tends to be carried through the drainage system. An exception to this is San Diego Creek below Campus Drive. In this reach, the wash load (mainly silt sizes) starts to settle as the velocity decreases. As a result, the bed material in this area contains appreciable quantities of silt size fractions, approximately 10 to 30 percent.

Most of the streams in the Upper Newport Bay watershed are characterized by sandy streambeds with no armoring layer. Also, no cohesive material is present in the channels to inhibit the detachment of particles into the flow. Under this condition, no matter how much sediment is produced from upslope areas or upstream reaches, the bed material load passing a given reach is determined by the transport capacity of the reach. If the supply of coarse sediment from upslope areas or upstream reaches is less than the sediment transport capacity, erosion will occur to satisfy the transport capacity. On the other hand, excess sediment supplied by upstream areas will deposit in the reach. Thus, the bed material load will eventually equal the sediment transport capacity of the reach.

Table 4 illustrates the transport characteristics of San Diego Creek under existing and ultimate conditions.

Figure 4 shows the average annual sediment production in Newport Bay Watershed from various sources for existing conditions and the amount delivered to Upper Newport Bay.

As can be seen from this table and figure, under existing conditions much of the sediment generated from upslope areas will be deposited in the stream before entering the Bay. On the other hand, the sediment delivered to the Bay under ultimate conditions is greater than that



TABLE 4  
AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
SAN DIEGO CREEK WATERSHED  
EXISTING AND ULTIMATE CONDITIONS (1)  
(1000 TONS)

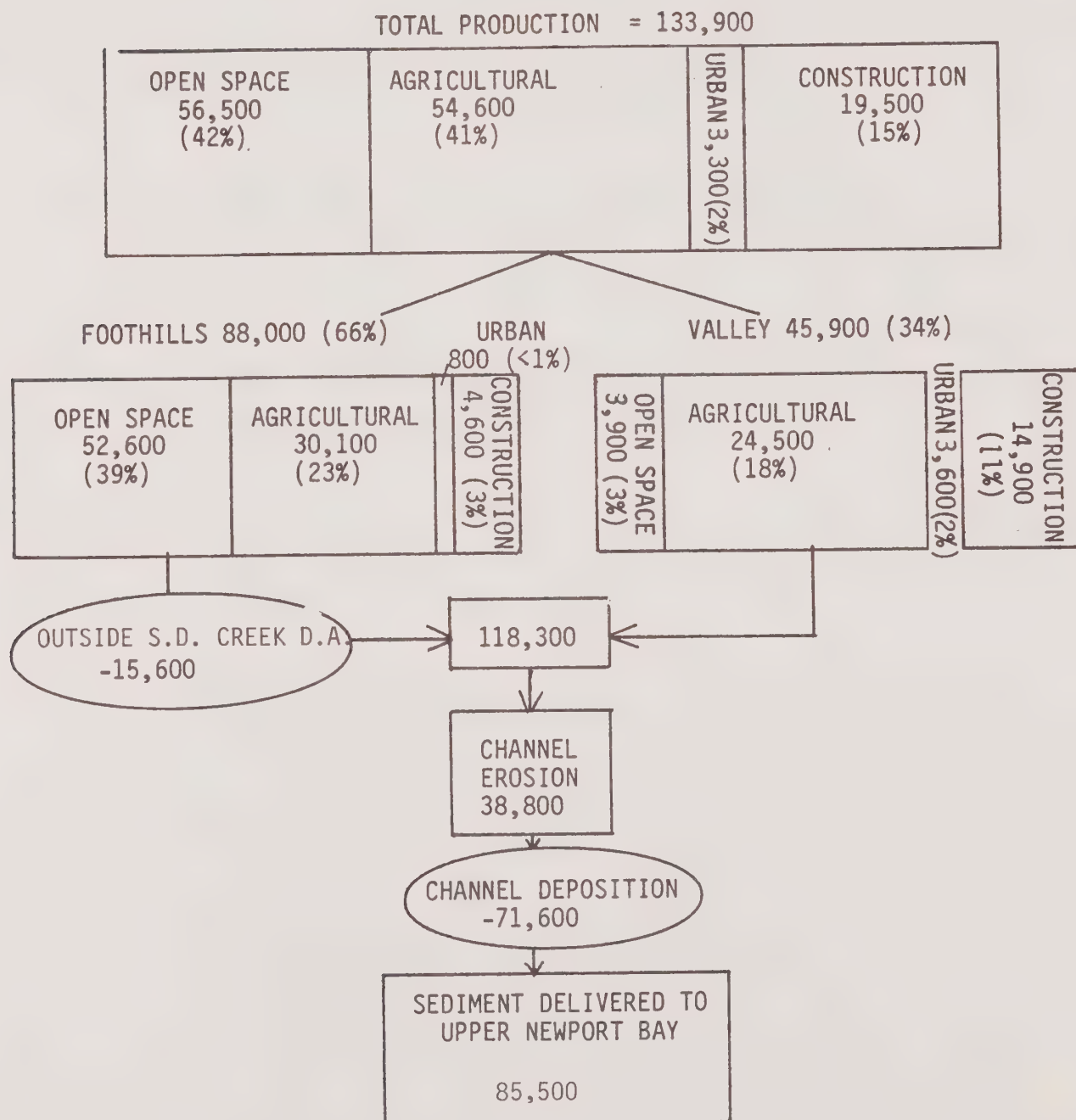
	<u>Existing Conditions</u>			<u>Ultimate Conditions (2)</u>		
	<u>Silt &amp; Clay</u>	<u>Coarser Sediment</u>	<u>Total</u>	<u>Silt &amp; Clay</u>	<u>Coarser Sediment</u>	<u>Total</u>
Sediment Produced						
Upslope Areas	78.0	40.3	118.3	39.0	23.5	62.5
Channel Erosion	0.6	38.2	38.8	--	90.7	90.7
	----	----	-----	----	-----	-----
Totals	78.6	78.5	157.1	39.0	114.2	153.2
Deposition in Channel Reaches	7.6	64.0	71.6	--	88.7	88.7
Sediment Delivered to Upper Newport Bay	71.0	14.5	85.5	39.0	25.5	64.5

(1) For conditions prior to the installation of the Early Action  
Action and Interim Plan.

(2) Assumes that additional channel stabilization measures are not installed.

FIGURE 4

AVERAGE ANNUAL  
SEDIMENT PRODUCTION IN NEWPORT BAY WATERSHED  
FOR EXISTING CONDITIONS (IN TONS) <sup>1/</sup>



<sup>1/</sup> For conditions prior to the installation of the Early Action and Interim Plan.

generated from the upslope areas. This is because urbanization causes increased runoff rates, and consequently a higher sediment transport capacity in the receiving stream. Channel scour results, increasing the quantity of sediment delivered downstream. The coarser particles of this scoured material would be deposited in channel reaches on flatter gradients. However, some increase in sand particles delivered to Upper Newport Bay would occur. The probable installation of channel stabilization measures concurrent with urban development, as necessary flood control measures, will reverse this tendency.

Figure 5 indicates the particle size distribution estimated for sediment entering Newport Bay under existing conditions and ultimate conditions. The higher percentage of sand particles estimated for ultimate conditions reflects the reduced amounts of the finer particles produced by surface and rill erosion and the increased channel erosion caused by increased flows with greater capacities for transporting sand particles.

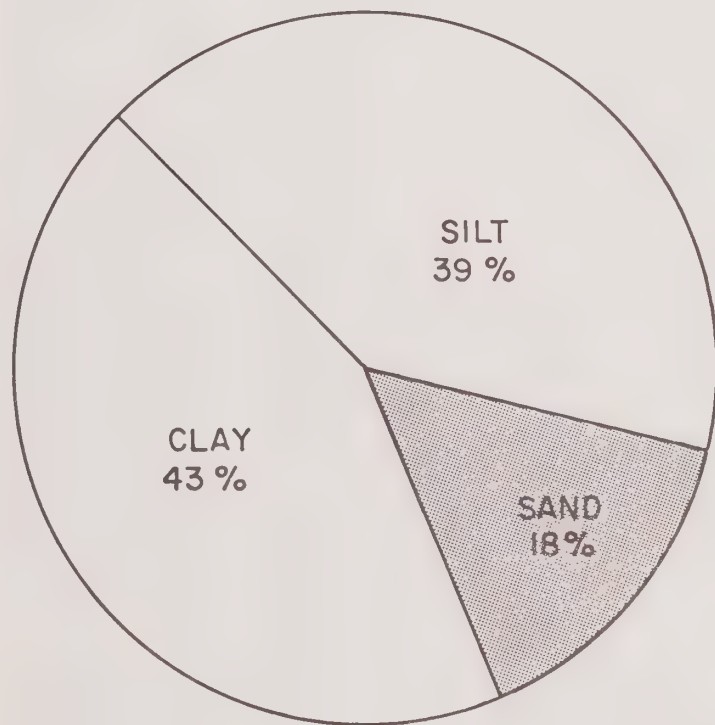
The sediment inflow to Newport Bay varies greatly with the amounts of runoff produced by storms in the watershed. Figure 6 compares the amounts of sediment inflow to Upper Newport Bay caused by storms of various return periods as a percentage of the estimated average annual sediment inflow.

The sediment transport analysis for ultimate conditions was made under the assumption that channel geometry and streambed materials are the same as those prevailing under existing conditions. However, when the sediment supply from upslope areas is limited, the streams will tend to reach equilibrium through slope adjustment or development of an armored layer, which was not considered in this study. Ultimately, the sediment delivered to the bay will be approximately equal to that generated from upslope areas on a long-term average basis. Thus, the results presented in this report for ultimate conditions should be viewed as conservative and temporary only until the equilibrium stage is reached. In addition, channel improvement during urban development will further reduce sediment delivery rates.

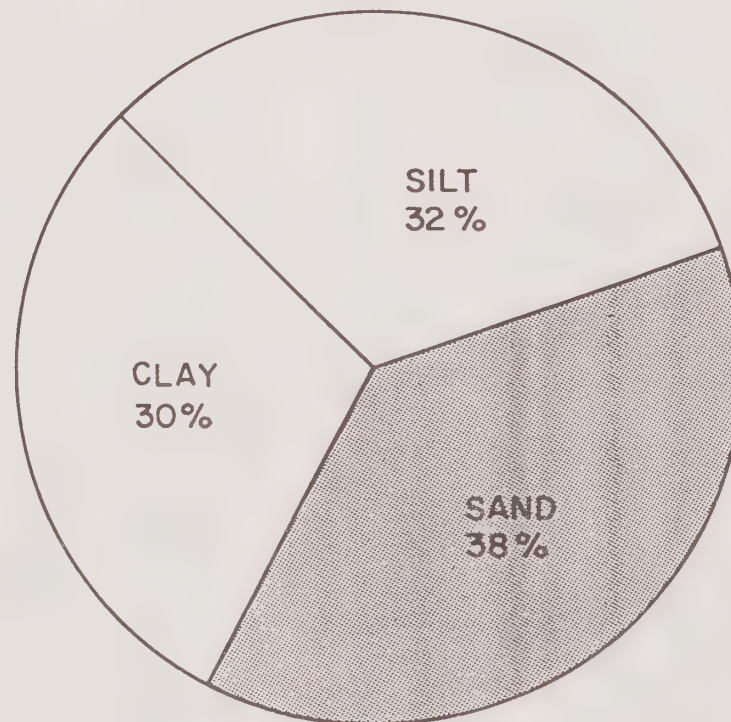
#### D. Transport, Deposition and Scour in Newport Bay

The technical memorandum for this task (II-E) was prepared by Ray B. Krone and Associates and Boyle Engineering Corporation. A description of the transport of sediments discharged by San Diego Creek into the hydrologic environment of Upper Newport Bay is presented in this technical memorandum.

Estuaries are regions of hydrologic transition from the varying fresh water discharges of influent streams to the tidal, saline oceans. The water movements, sediment distribution processes, and biology throughout estuarial regions are influenced by both the stream discharges and the ocean tides, and salinity. Upper Newport Bay hydrology is characteristic of such estuaries in areas having seasonal rainfall.

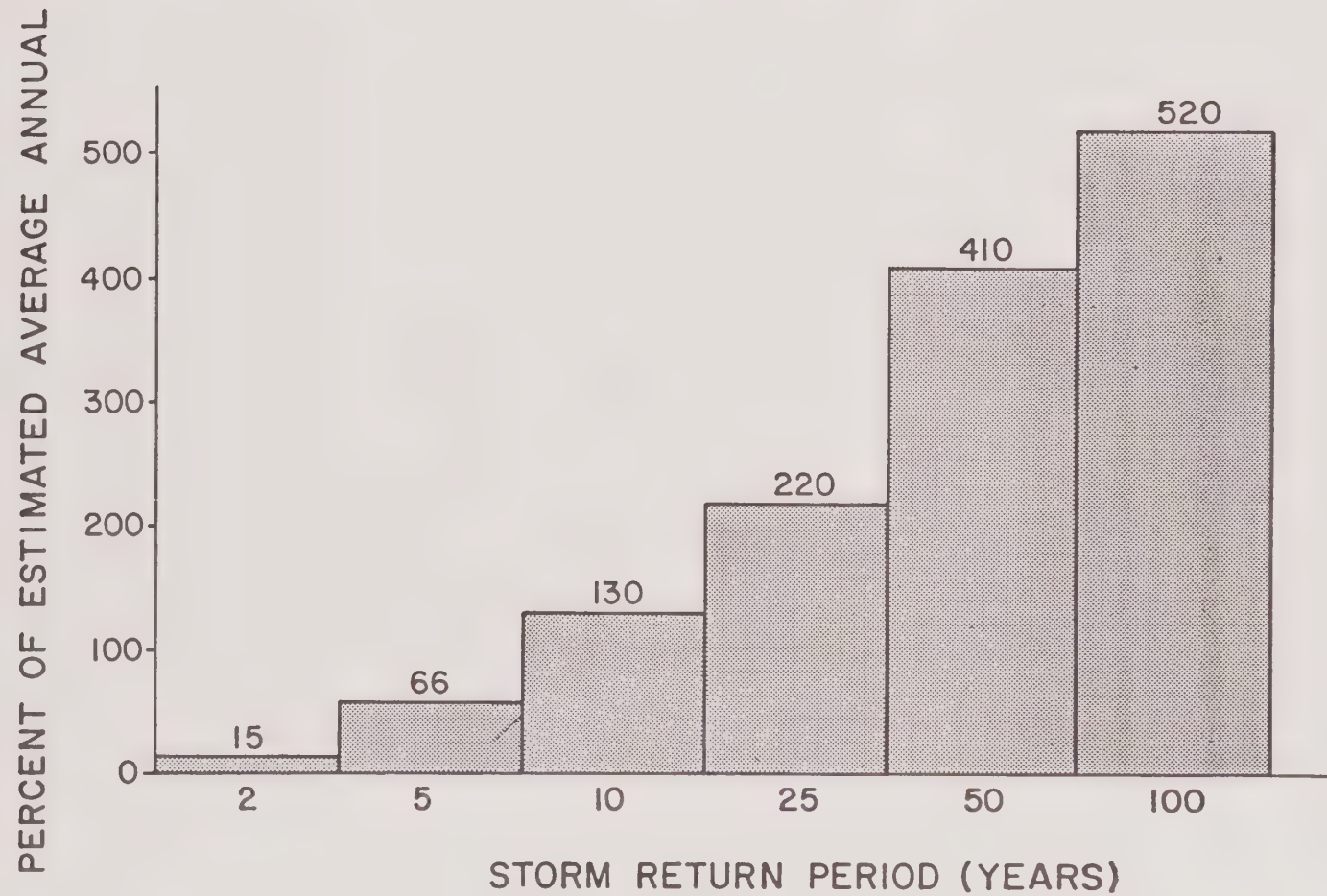


EXISTING  
CONDITION



ULTIMATE  
CONDITION





Water circulation is caused by tidal currents, streamflows, gravity circulation due to the greater density of seawater than freshwater, and waves caused primarily by the spring and fall Santa Ana winds.

Sand and coarse silt grains are transported as discrete particles. The quantities transported vary in relation to the amount of streamflow. These particles have appreciable settling velocities and when the flows are reduced, with consequent reduction in velocities, they tend to deposit or to be carried as bed load.

Clay and fine silt particles are transported as either discrete particles or small aggregates in the freshwater of the San Diego Creek drainage system. Because of their small sizes, they have very low settling velocities, with the result that they rarely settle to the bed, even at low discharges. These particles are referred to as "wash load". When stream waters mix with ocean waters to the extent of one or two parts or more of ocean water to 32 parts streamwater, the particles become cohesive. Even though the particles are mutually repulsive in fresh runoff water, they become cohesive as the waters enter an estuary.

In quiescent or slowly flowing waters, these aggregates of suspended particles settle to the bed and stick. As the accumulation grows thicker, the weight of the deposit crushes the lower aggregates in the bed, making the bed denser and stronger. Erosion of a cohesive bed by slightly increased currents or by moderate wave action may erode just the weak surface or, if the wave or current stress on the bed is stronger, it may erode deeper.

Sand transport, of discrete grains having high settling velocity, tends to maintain equilibrium with the bed, depending on the flow or wave action; and sand deposits do not normally become more resistant to erosion with consolidation. Fine cohesive particles, in contrast, may have changing settling velocities, depending on dissolved salt concentrations and hydraulic conditions; and the strength of a cohesive sediment bed increases with depth, at least to a foot or more.

During stormflow, the fine sand is transported predominantly in suspension. As the stormwaters discharge from the confined channel and spread in the upper end of Upper Bay, the sands rapidly settle to the bed, and a delta-like deposit forms. Subsequent stormflows may work such deposits, and if the flow is sufficiently strong, channels may be maintained across the deposit. Terrestrial vegetation has been established on the sand deposit from the 1969 storm. This vegetation will slow flood flows and will increase further the rate of sand deposition.

During the short, intense stormflows into Upper Newport Bay, the freshwater spreads over the surface of the basin above The Narrows. When the tide is rising, the freshwater flow down the Bay is reversed. As the tide falls, however, the flow down the Bay is enhanced by the extra water that is supplied by the stream. The effect is more

pronounced for large flows than for small flows. The near-surface freshwater flows through Lower Bay to the ocean.

Clay and fine silt are deposited in the upper basin, located between The Narrows and the old salt works dike, (Figure 7) when the stormwaters spread there at moderate to high tides. A small portion of unaggregated material, however, is carried with the fresher surface flow to the ocean during moderate to large storms.

The fraction of the clay and fine silt that is transported directly to the ocean during a storm event varies with the discharge. A very large discharge would be expected to carry a large portion because a greater displacement of saline water would occur in the upper basin. The fraction would not be large, however, even for a large storm. The fraction approaches zero for moderate storms.

The new deposit in the upper basin can be reworked by wave action that occurs during windy periods. Even small waves can suspend mud when the water is shallow. Such conditions occur near the end of a falling tide, and suspended sediments can be carried toward Lower Bay. The stratified flows that occur, however, would return such material to the upper basin. The bed contours in the basin below the sand encroachment appear to be those resulting from wave action. Resuspension by wave action tends to winnow the fines from the deposit. Tidal currents redistribute suspended fine material into regions where wave action is less intense.

The above description indicates that most of the fine material is deposited in the upper basin. There is very limited information with which to verify this conclusion. The study "Water Quality in Newport Bay and its Watershed" reported that 180 acre-feet of deposit accumulated in Upper Newport Bay during the period 1973 to 1979. Most of this deposited between 2.0 and 4.0 ft. mean lower low water (MLLW). A total sediment supply of 277,000 metric tons of sediments were supplied during this period, as calculated from stream records. It was estimated that nearly all of the material was trapped in the upper basin. Figure 7 illustrates the pattern of sediment deposition in Upper Newport Bay for the period 1968-1977.

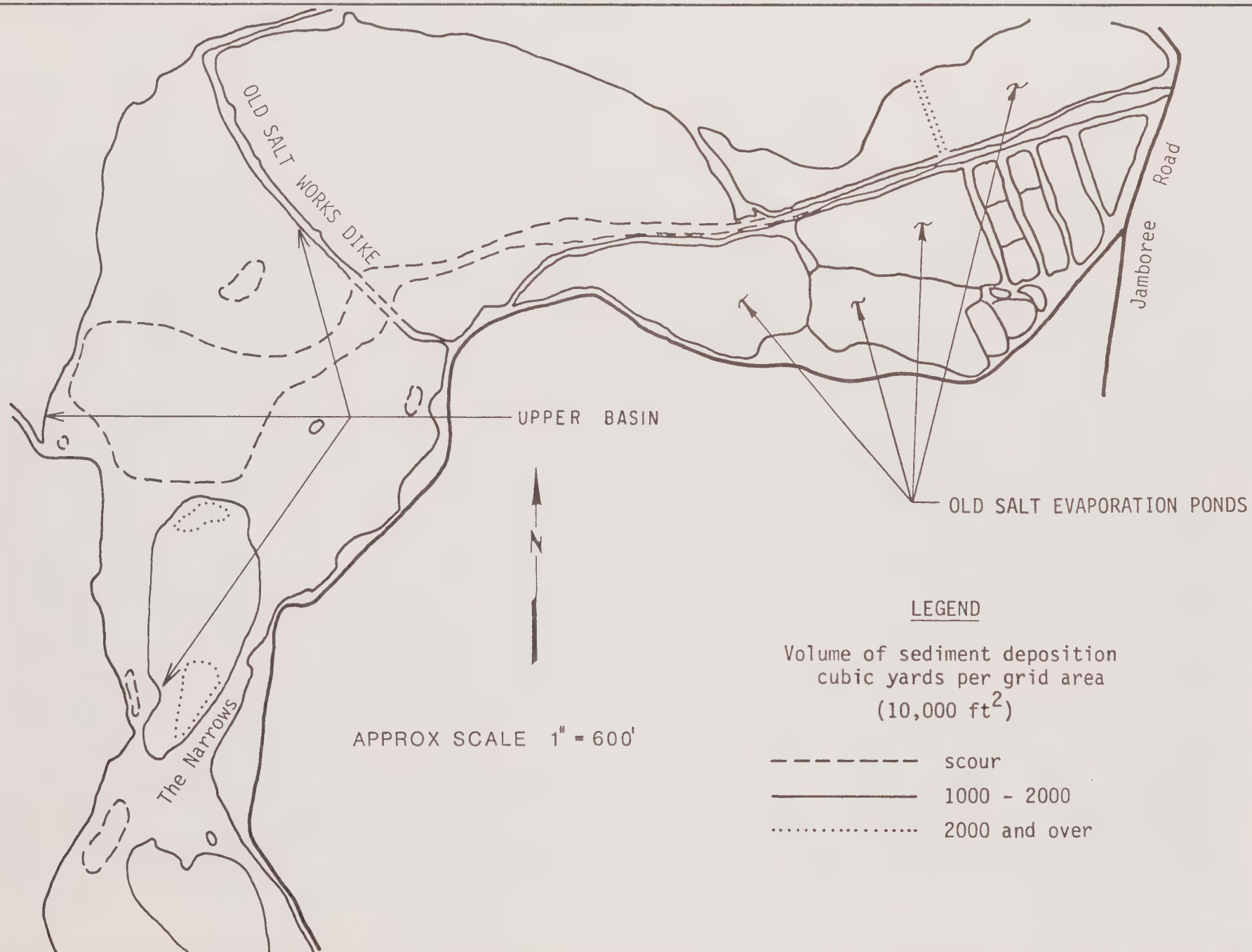
#### E. Sedimentation Effects on the Bay

If the system is left as it is, there are foreseeable changes that will occur. The processes described above will continue at rates that depend on the occurrence of storms.

Terrestrial vegetation is already established on the sand deposits at the northern end. The plants will slow stormflows that are high enough to pass through them, and the elevation will rise after each such event. Otherwise, the delta-like deposits will continue to encroach into the upper basin.

Clay and silt will accumulate in the basin to a depth where wave action can erode as much material over a year as deposits there. The basin will be a big mud flat. It is almost there. Marsh plants will







become established in areas sheltered from the wind, and elevated marshes will develop there. These and the old marshes will absorb some of the fine sediment suspended by wave action.

As the volume of the upper basin decreases due to the advancing sand deposit, the developing marsh, and the rising mud flat, the volume of the tidal prism of northern Upper Bay will diminish. Tidal currents in the channel will have lowered maxima, and fine sediment will accumulate along channel edges, constricting the channel cross sections until the currents are strong enough to move any additional sediment. As the volume of the upper basin decreases, the fraction of the clay and silt that exits to the ocean will increase. There will probably be some accumulation of fines in Lower Bay when the amount of silt and clay that reach Lower Bay become significant. Later, when sand deposits have advanced to The Narrows, sand will reach Lower Bay during large storms.

As the upper basin fills with sand and the channels become constricted, the frequency of flooding the marshes with storm flows will increase. Deposition on the marshes will remove fines, and the marsh surface elevations will rise slowly.

The following conclusions regarding transport of sediments from San Diego Creek to Upper Newport Bay appear appropriate on the basis of the above-described sediment transport characteristics.

1. The sand fraction and coarse silt is retained in the northern end of Upper Bay. It will continue to encroach on the basin above The Narrows.
2. Most of the fine silt and clays deposit in the basin north of The Narrows. A small portion exits to the ocean at the water surface during a storm. More than 80 percent of the clay and fine silt particles is retained in the upper basin.
3. Marshes will develop wherever mud accumulates above the elevation of +2.0 ft. mean lower low water (MLLW).
4. If the present situation continues, the upper basin will continue to fill with mud and sand and its effectiveness in trapping fine sediment will diminish.
5. Regular and systematic assessment of the progress of sedimentation is strongly recommended.

#### IV. EVALUATION AND COMPARISON OF ALTERNATIVE PLANS FOR SEDIMENT CONTROL

A management system for the control of sediment inflow to Upper Newport Bay will be composed of measures to reduce sediment production from the watershed lands and measures to trap sediment which enters the stream system to prevent its continuing downstream into the Bay.

Sediment production from the watershed lands should be reduced to the maximum extent feasible. Control of erosion reduces the quantities of sediment of all particle sizes that enter the stream system and the potential for deposition in the channel system, downstream structural measures and Newport Bay.

Under existing conditions, the major source of sediment is the foothill area which produces 66 percent of the total from an area of 41.4 square miles. The valley area produces the remaining 34 percent from an area of 107.4 square miles.

For the total watershed, open space produces 42 percent of the sediment from about 28 percent of the area. About 93 percent of this amount is from the foothill area which includes only about 26 percent of the area in open space.

Agricultural areas produce about 41 percent of the total from about 23 percent of the total area. About 55 percent of this amount is from the foothill area which includes only about 26 percent of the agricultural area.

Areas under construction produce about 15 percent of the total from about two percent of the total watershed area. This is a transient condition that continues only through the construction period, but it is anticipated that this rate of construction exposure will continue until the agricultural lands and a large part of the open space areas have been changed to urban uses.

Urban areas produce only about two percent of the total from about 47 percent of the watershed area. As the watershed becomes urbanized, up-slope sediment production will be greatly reduced. However, stormflows will be greatly increased because of the larger amounts of impervious surfaces on the watershed. This will cause more channel erosion unless coordinated channel stabilization measures are installed as this urban development occurs.

There are opportunities for reducing sediment production from the watershed by the application of best management practices (BPMs) on agricultural and construction areas.

Sediment control plans for agricultural areas and construction sites in the Upper Newport Bay watershed have been developed in technical memoranda for Task 8015-02 (Agricultural Activities Interim Sedimentation Control Plan) and Task 8015-03 (Construction Activities Best Management Practices Plan for Sediment Control).

The report on the Upper Newport Bay Agricultural Activities Interim Sedimentation Control Plan includes an analysis of the best management practices (BMPs) which are applicable to agricultural lands in the watershed area. This report specifies problem areas and BMPs for possible implementation to control these problems.

The implementation of these additional BMPs on agricultural lands will require site-specific Resource Conservation Plans to determine the additional measures that should be applied. A high priority should be placed on the early application of measures that reduce sediment production. Many of these measures will be structural measures such as drop boxes and stabilized outlet ditches to convey runoff waters without causing erosion. Properly located access roads in foothill orchards with provisions for drainage will help to minimize erosion.

The report on Newport Bay Watershed: Construction Activities Best Management Practices for Sediment Control specifies best management practices to reduce sediment production from construction sites. These BMPs include structural measures for use at sites described in the report, and nonstructural measures involving administrative and regulatory procedures.

The application of additional BMPs on agricultural and construction areas will reduce sediment production from that which occurs under existing conditions. However, it is not feasible to quantify the amounts of sediment reduction that would be obtained.

In estimating sediment production under existing conditions, it was assumed that BMPs would continue to be applied to agricultural and construction areas at the present rate of effectiveness. Many of these measures are now being applied. Additional applications of these measures will further reduce the amounts of sediment produced from these areas. It is important that this reduction be accomplished but the needs for structural measures will not be significantly changed.

As the use of these lands is changed to mature urban development with coordinated channel stabilization measures, sediment production will be further reduced.

Minimizing upstream erosion will reduce sediment production with consequent reduction in downstream maintenance costs for the removal of sediment deposited in the channels and Newport Bay. Therefore, the continued application of agricultural and construction BMPs together with the implementation of the recommendations contained herein should be included in combination with any management system selected.

Six alternative management systems were considered for the structural control of sediment that will continue to enter the stream system. These management systems are composed of one or more elements that will cause reductions in the sediment discharged into Upper Newport Bay. They were evaluated solely on the basis of their effectiveness in reducing sediment inflow to Upper Newport Bay.

Some of these elements included in the alternative management systems will provide primary benefits other than sediment control with sediment control



an important but secondary benefit accruing from their installation. These include channel stabilization measures and the installation of the foothill basins. The sole benefits to be obtained from the installation of in-channel sedimentation basins are reductions in the sediment inflow to Upper Newport Bay.

With the full development of the San Diego Creek watershed a large portion of all of these elements will be installed with progressively more effective control of the sediment produced in the watershed.

The detailed analyses for these alternatives are included in the Technical Memoranda for Task III-D, Development and Comparison of Alternative Management Systems, and for Task III-E, General Audience Report, Stormflow Sedimentation Control Alternatives. Following are summaries of these evaluations.

#### A. Relative Effectiveness and Costs

##### 1. Alternative 1 - No Project

Under this alternative management system, it is assumed that no measures will be implemented to control sediment production and transport within the watershed. These conditions are those estimated to have existed prior to the implementation of the Early Action and Interim Plan.

Table 5 summarizes the characteristics of sediment production and deposition in the San Diego Creek watershed prior to the installation of the Early Action and Interim Plan. The sediment produced from upslope areas is composed of high percentages of silt and clay and a relatively small percentage of sand particles. Using the methodology explained in Section III of this report the estimated sediment produced by channel erosion is composed predominantly of sand particles. The sediment deposited in channel reaches having the flatter gradients is composed almost entirely of sand particles and includes about 82 percent of the total sand particles produced by the upslope areas and channel erosion. Consequently, the sediment inflow to Upper Newport Bay is composed primarily of silt and clay (83 percent) with a relatively small amount of sand particles (17 percent).

Deposition in the channel system occurs almost entirely in the reach of San Diego Creek between the confluence with Peters Canyon Wash and Sand Canyon Avenue (45,100 tons) and the reach between the junction with Peters Canyon Wash and the outlet into Upper Newport Bay at Jamboree Road (26,500 tons).

The estimated average annual sediment inflow to Upper Newport Bay under existing conditions is 85,500 tons composed of 71,000 tons of silt and clay and 14,500 tons of sand particles. This amount is between that estimated to be delivered by the 5-year return period storm (56,800 tons) and that of the 10-year return period storm (109,400 tons). The amount estimated to be delivered by the 100-year return period storm is 443,400 tons.



TABLE 5

AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
SAN DIEGO CREEK WATERSHED  
(EXISTING CONDITIONS) (1)

	Particle Size Distribution Tons				
	Total Tons	Clay	Silt	Fine Sand	Coarse Sand
Sediment Produced					
Upslope Areas	118,300	36,600	41,400	28,600	11,700
Channel Erosion	38,800	400	200	31,700	6,500
	-----	-----	-----	-----	-----
Total Sediment Produced	157,100	37,000	41,600	60,300	18,200
Deposition in Channel Reaches	71,600	-600	8,200	46,700	17,300
	-----	-----	-----	-----	-----
Sediment Delivered to Upper Newport Bay	85,500	37,600	33,400	13,600	900
	-----	-----	-----	-----	-----

(1) (Prior to the Installation of the Early Action and Interim Plan)

The estimated average annual cost to remove deposited materials from flood control channel sections at 1982 prices will be about \$214,800 (71,600 cu. yds. at \$3 per cu. yd.). One ton approximates one cubic yard.

The estimated average annual cost to remove sediment deposited in Newport Bay is \$641,250 (85,500 cu. yds. at \$7.50 per cu. yd.). On this basis, the total estimated average annual cost to remove and dispose of sediment deposited in the channel system and Newport Bay would be \$856,050.

As discussed in a previous section of this report, it is estimated that all of the sand that enters Upper Newport Bay from San Diego Creek is deposited in the northern end of Upper Bay, which is primarily the area north of the old salt works dike (Figure 7). The major deposition of silt and clay particles occurs in the area between The Narrows and the old salt works dike. This occurs because of a combination of factors including reduced velocities, flocculation on contact with saline waters and the effects of tidal variations.

As urban development continues in the watershed, upslope sediment production will decrease and channel erosion will increase unless coordinated channel stabilization measures are installed as development occurs. The percentage of silt and clay included in the sediment delivered to Upper Newport Bay will decrease because of the reduced sediment production from upslope areas and the amounts of sand particles will increase because of channel erosion. The amounts of sand particles deposited in channel reaches on the flatter gradients will also increase.

## 2. Alternative 2 - Channel Stabilization Measures Only

Channel erosion produces large amounts of sediment and increases the total sediment load in the flood flows considerably. As discussed in Section III-C of this report, it has been assumed that the total amount of sediment from channel erosion is from downcutting with a relatively insignificant amount produced by bank erosion. The sediment produced by downcutting is composed predominantly of sand particles. The sediment produced by bankcutting has relatively high percentages of silt and clay particles ranging from 10 to 55 percent. To the extent that bankcutting occurs, the total sediment produced by channel erosion will contain higher percentages of silt and clay particles.

Tables 4 and 5 and other tabulations of estimated sediment produced by channel erosion are based on the assumption that it is produced entirely by downcutting.

Table 5 shows the estimated average annual amounts of sediment produced by channel erosion under existing conditions. Table 4 compares the amounts of sediment produced by channel erosion under existing conditions with those estimated to occur under conditions

of ultimate development without the installation of channel stabilization measures.

Table 6 indicates the average annual sediment production and deposition in the San Diego Creek watershed under otherwise existing conditions but assuming all channels are stabilized and no sediment is produced by channel erosion. This analysis indicates that sediment inflow to Upper Newport Bay would be reduced 6100 tons (85,500-79,400), all of which are indicated as sand particles.

Table 7 indicates the average annual sediment production and deposition in the San Diego Creek watershed under conditions of ultimate development assuming all channels are stabilized and no sediment is produced by channel erosion. This analysis indicates that sediment inflow to Upper Newport Bay would be reduced 17,400 tons (64,500-47,100), essentially all of which are indicated as sand particles.

Figure 8 illustrates sediment production and transport in the Newport Bay Watershed under conditions of ultimate development with and without channel stabilization.

The elimination of channel erosion in the watershed is estimated to reduce sediment inflow to Upper Newport Bay about 7 percent under existing conditions and about 27 percent under conditions with ultimate development. Under the assumption that sediment produced by channel erosion is composed almost entirely of sand particles, these decreases in sediment inflow to Upper Newport Bay would be composed essentially of sand particles. To the extent that additional sediment is produced by channel bank erosion the estimated effectiveness of channel stabilization measures in reducing sediment inflow to Upper Newport Bay would be increased, including a reduction in silt and clay particles as well as a further reduction of sand particles.

It is apparent that the installation of channel stabilization measures will become progressively more important as urban development continues in the watershed. However, they are not of primary importance in reducing sediment inflow to Upper Newport Bay under existing conditions. The material produced by channel erosion decreases channel capacities by deposition and increases channel maintenance costs.

The costs to stabilize all channels within the watershed were not estimated. It is anticipated that this work will be accomplished concurrently with urban development.

The estimated average annual cost under existing conditions to remove deposited materials from flood control channel sections at 1982 prices with this alternative installed would be about \$116,700 (38,900 tons at \$3 per ton) and for the removal of sediment deposited in Newport Bay about \$595,500 (79,400 tons. at

TABLE 6  
AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
ASSUMING ALL CHANNELS STABILIZED  
(EXISTING CONDITIONS) 1/

	Total Tons	Particle Size Distribution Tons			
		Clay	Silt	Fine Sand	Coarse Sand
Sediment Produced					
Upslope Areas	118,300	36,600	41,400	28,600	11,700
Channel Erosion	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>
Total Sediment Produced	118,300	36,600	41,400	28,600	11,700
Deposition					
Channel Deposition	<u>38,900</u>	<u>500</u>	<u>6,700</u>	<u>20,800</u>	<u>10,900</u>
Sediment Delivered to Upper Newport Bay					
W/Channel Stabiliza- tion Measures	79,400	36,100	34,700	7,800	800
W/O Channel Stabiliza- tion Measures	85,500	37,600	33,400	13,600	900
Reduction with Measures	6,100	1,500	-1,300	5,800	100

1/ For conditions prior to installation of the Early Action and Interim Plan.



TABLE 7

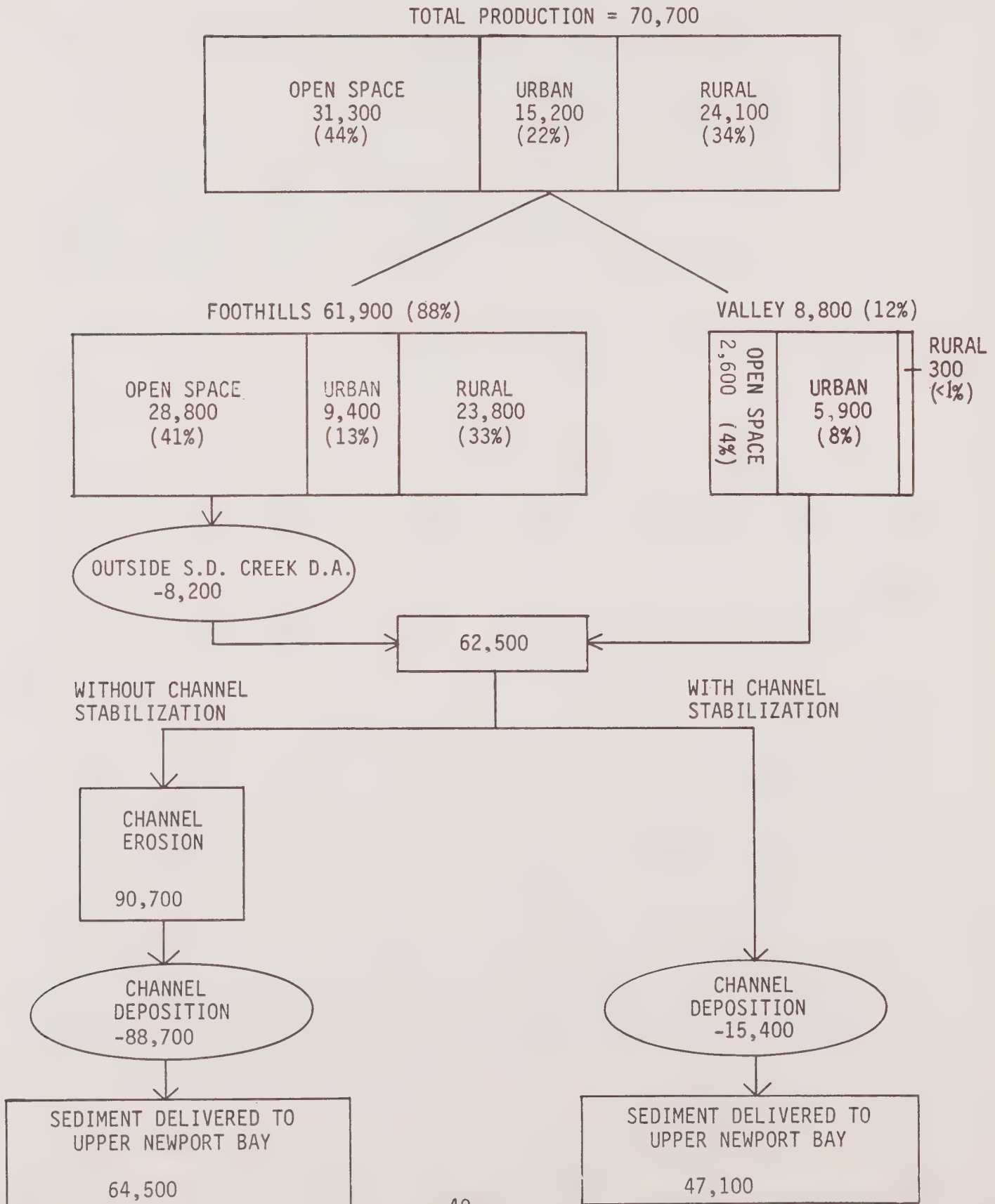
AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
 ASSUMING ALL CHANNELS STABILIZED  
 (ULTIMATE CONDITIONS) 1/

	Total Tons	Particle Size Distribution Tons			
		Clay	Silt	Fine Sand	Coarse Sand
Sediment Produced					
Upslope areas	62,500	18,500	20,500	14,900	8,600
Channel Erosion	--	--	--	--	--
Total Sediment Produced	62,500	18,500	20,500	14,900	8,600
Deposition					
Channel Deposition	15,400	300	100	7,500	7,500
Sediment Delivered to Upper Newport Bay					
W/Channel Stabilization Measures	47,100	18,200	20,400	7,400	1,100
W/O Channel Stabilization Measures	64,500	19,400	20,600	23,200	1,300
Reduction with Measures	17,400	1,200	200	15,800	200

1/ For conditions prior to installation of the Early Action and Interim Plan.

FIGURE 8

AVERAGE ANNUAL  
SEDIMENT PRODUCTION IN NEWPORT BAY WATERSHED  
FOR ULTIMATE CONDITIONS (IN TONS) <sup>1/</sup>



<sup>1/</sup> For conditions prior to the installation of the Early Action and Interim Plan.

\$7.50 per ton) for a total estimated average annual maintenance cost of about \$712,200.

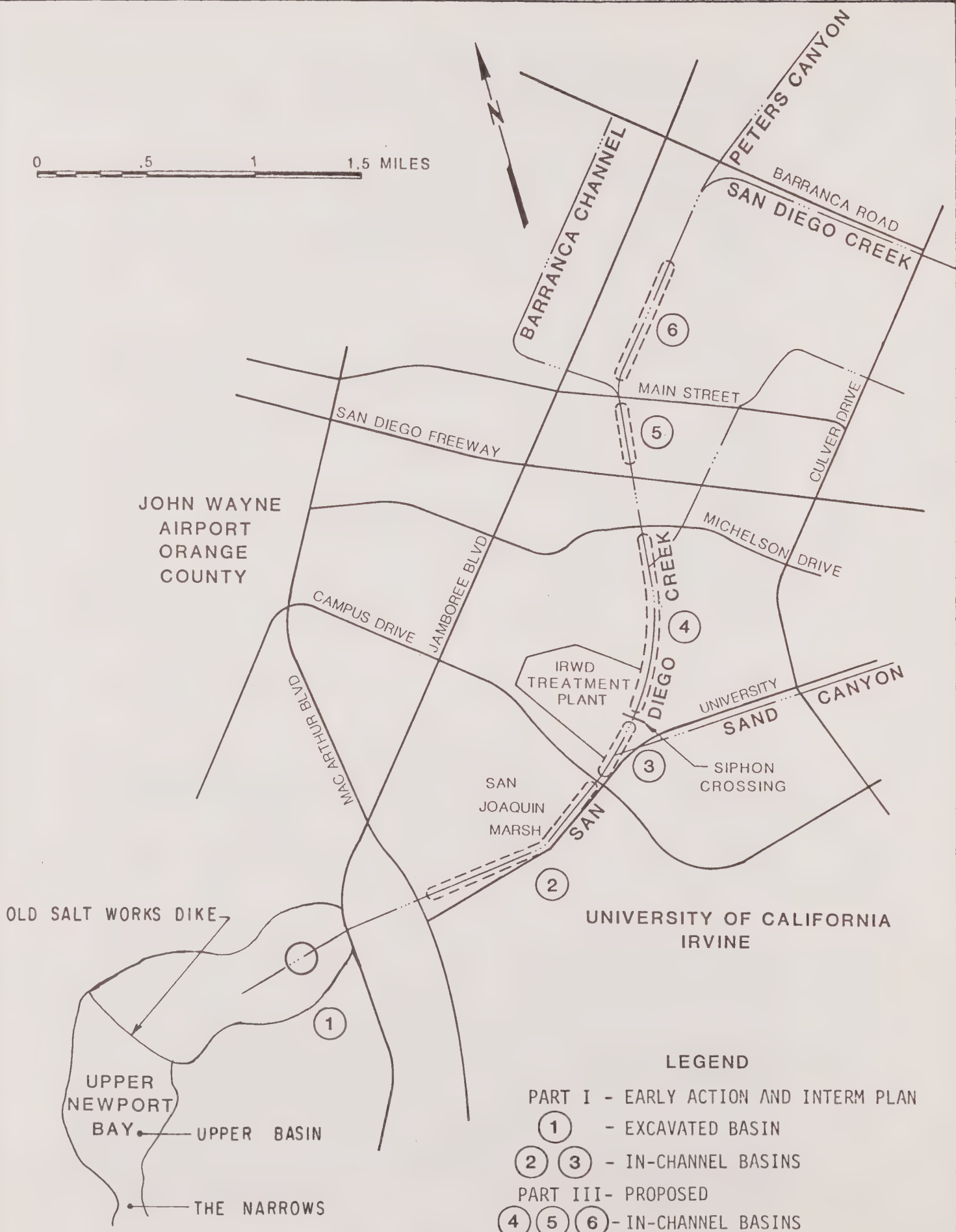
The estimated average annual costs under ultimate conditions of development to remove deposited materials from flood control channel sections at 1982 prices with this alternative installed would be about \$46,200 (15,400 tons at \$3 per ton) and for the removal of sediment deposited in Newport Bay about \$353,200 (47,100 tons) at \$7.50 per ton) for a total estimated average annual maintenance cost of \$399,450.

Under ultimate conditions of development without channel stabilization measures, the estimated average annual cost to remove deposited materials from flood control channel sections would be about \$266,100 (88,700 tons at \$3 per ton) and for the removal of sediment deposited in Newport Bay about \$483,750 (64,500 tons at \$7.50 per ton) for a total estimated average annual maintenance cost of \$749,850. These estimates are based on the assumption that channel-eroded material is obtained from downcutting only and is composed almost entirely of sand particles. If channel erosion includes significant amounts of bankcutting, the content of silt and clay particles will increase and larger amounts of sediment from channel erosion will be transported to the Bay. Consequently, maintenance costs will be greater as it costs more to remove sediment from the Bay than from the channels. Adverse environmental impacts on the Bay will also be greater.

### 3. Alternative 3 - Control Measures Included in the Early Action and Interim Plan

In Part I of this study, various sites were considered for sedimentation basins upstream from Newport Bay, including Site A (area south of San Diego Creek between Jamboree Road and MacArthur Boulevard) and Site B (area surrounding the IRWD wastewater treatment plant). It was determined that in-channel sedimentation basins met the criteria established for an Early Action and Interim Plan better than the alternative upstream control measures considered.

Two in-channel debris basin sites upstream from MacArthur Boulevard were selected for inclusion in the Early Action and Interim Plan (Basin Nos. 2 and 3 on Figure 9. These basins are located within the existing right-of-way for the San Diego Creek flood control channel and provide sediment storage capacity below the design invert elevations of the flood control channel. They have been installed and were in operation during the 1982/83 rainy season. The first of these basins (No. 2) begins immediately upstream from MacArthur Boulevard and extends to Campus Drive. The effective length of the basin is 4450 feet and provides a storage capacity of about 210,000 cubic yards (130 acre-feet) below the invert elevation of the flood control channel.



OLD SALT WORKS DIKE

UPPER NEWPORT BAY

UPPER BASIN

THE NARROWS

- LEGEND**
- PART I - EARLY ACTION AND INTERM PLAN
  - ① - EXCAVATED BASIN
  - ② ③ - IN-CHANNEL BASINS
  - PART III- PROPOSED
  - ④ ⑤ ⑥ - IN-CHANNEL BASINS

**SAN DIEGO CREEK WATERSHED  
DOWNSTREAM PROJECTS**



**Boyle Engineering Corporation**  
consulting engineers / architects



The channel is excavated to elevation 0 mean sea level (MSL) at MacArthur Boulevard, which is 5 feet below the design invert elevation for the flood control channel. The excavation continues at elevation 0 MSL to the upper end of the basin where the depth of excavation is in excess of 9 feet.

The bottom width of the flood control channel is 250 feet. Strips 30 feet wide are not excavated on each side of the channel bottom providing an excavated top width of 190 feet as shown on Figure 10. The side slopes of the excavated debris basin are 3 horizontal to 1 vertical. The undisturbed 30-foot strips improve slope stability for the additional depths of excavation. They also provide areas which may be left in permanent vegetation to obtain wildlife values.

A weir structure is installed at MacArthur Boulevard as illustrated on Figure 11. A low-flow channel extending from MacArthur Boulevard to Upper Newport Bay provides drainage from the basin.

A grade stabilization structure has been installed at the upper end of the basin to prevent upstream erosion (Figure 11).

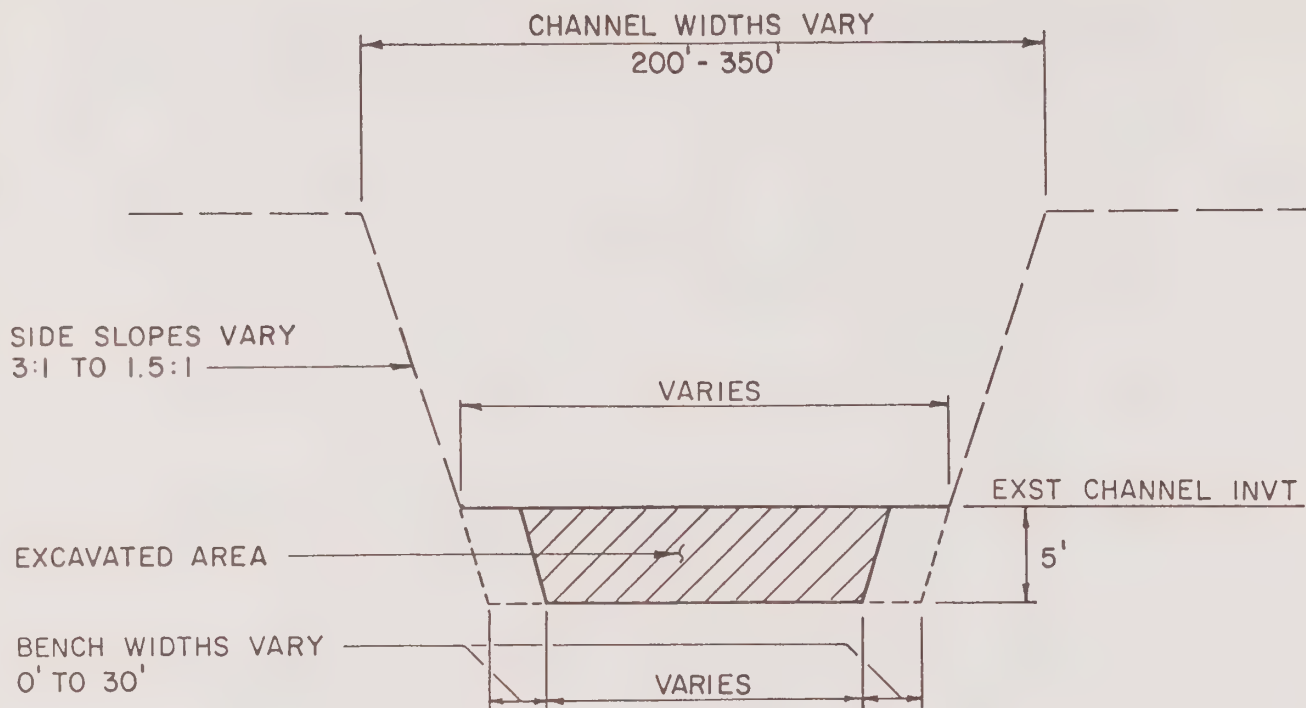
Another basin (No. 3) begins immediately upstream from Campus Drive and extends to the siphon crossing San Diego Creek to the Michelson Treatment Plant. The effective length of this basin is about 1820 feet and provides an additional storage capacity of about 72,600 cubic yards (45 acre-feet) below the invert elevation of the flood control channel.

It is excavated to a depth of 5 feet below the invert elevation of the flood control channel at Campus Drive and continues on the level to the siphon crossing, at which point it has a depth of about 7 feet. The cross section of the channel is the same as for the downstream basin. A weir structure at Campus Drive and a drop structure at the siphon crossing are included. The design for these structures is essentially the same as for the downstream basin.

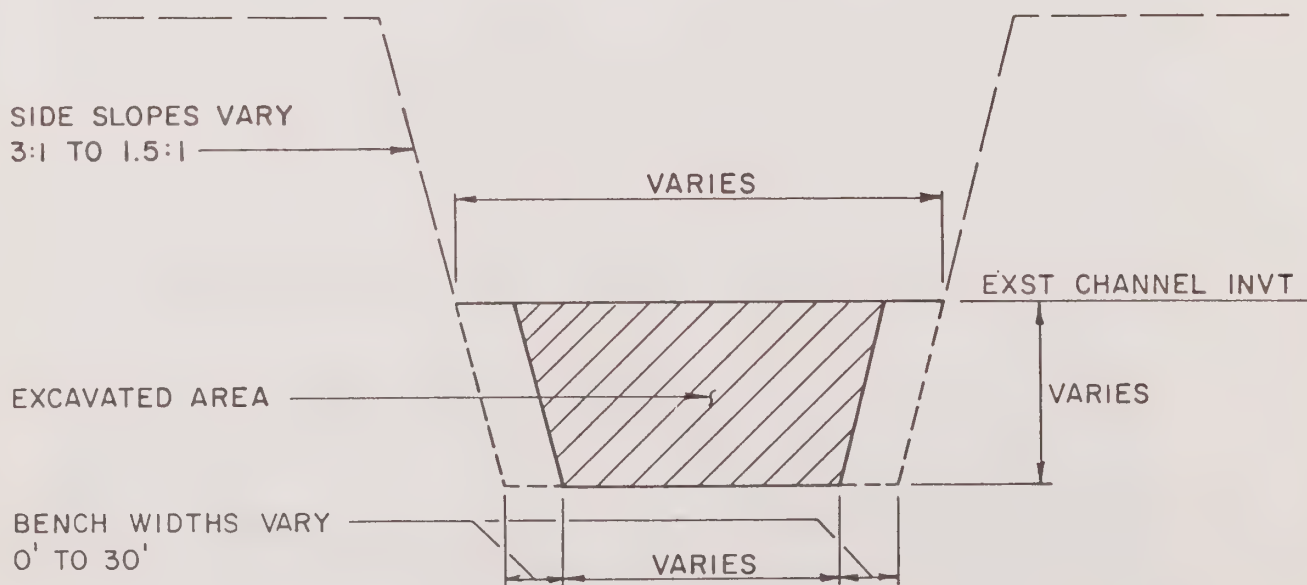
The total installation cost for these two in-channel basins was \$2,230,000, or about \$7.90 per cubic yard of excavated capacity provided.

Table 8 summarizes the average annual deposition that is estimated to occur in the two in-channel basins. These basins are estimated to trap about 25,000 tons of sediment that would not have normally deposited in the channel reach in which they are located. The sediment inflow to Upper Newport Bay is estimated to be reduced by 29 percent to 60,500 tons. The additional trapped sediment will be composed of silt and fine sand in about equal parts.

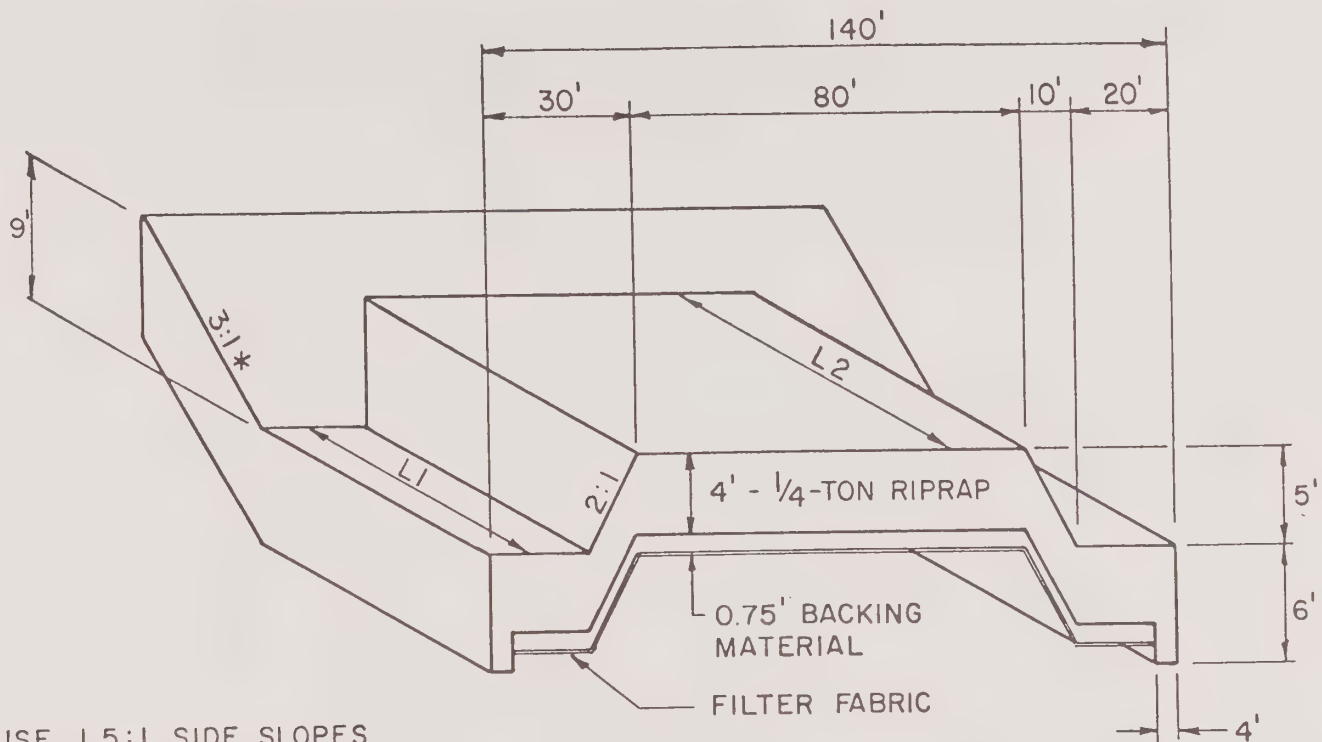
These two basins with their combined total sediment storage capacity of 282,000 cubic yards (175 acre-feet) cannot maintain good trap efficiency with a large infrequently-occurring stormflow



### DOWNSTREAM SECTIONS

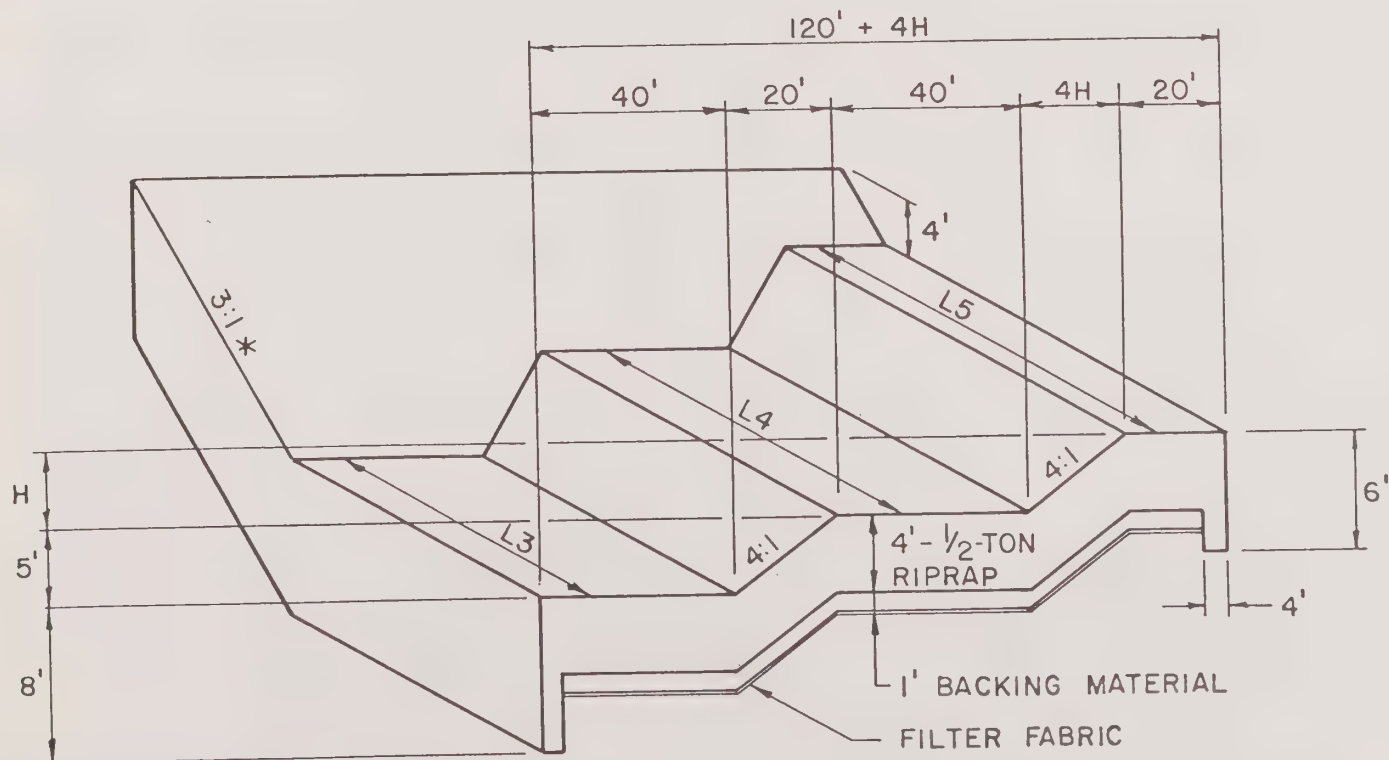


### UPSTREAM SECTIONS



\* USE 1.5:1 SIDE SLOPES  
UPSTREAM OF SAN DIEGO  
FREEWAY

WEIR STRUCTURE



DROP STRUCTURE

TABLE 8

AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
WITH IN-CHANNEL BASINS NO. 2 AND 3 INSTALLED  
EARLY ACTION AND INTERIM PLAN  
(EXISTING CONDITIONS)

	Total Tons	Particle Size Distribution Tons			
		Clay	Silt	Fine Sand	Coarse Sand
Sediment Produced					
Upslope Areas	118,300	36,600	41,400	28,600	11,700
Channel Erosion	38,800	400	200	31,700	6,500
Total Sediment Produced	157,100	37,000	41,600	60,300	18,200
Deposition					
In Basins	46,700	--	21,500	22,200	3,000
Add'l Channel Deposition	49,900	-300	300	35,600	14,300
Total Deposition	96,600	-300	21,800	57,800	17,300
Sediment Delivered to Upper Newport Bay					
With Basins	60,500	37,300	19,800	2,500	900
Without Basins	85,500	37,600	33,400	13,600	900
Reduction with Basins	25,000	300	13,600	11,100	-



or when sediment accumulations are not removed, resulting in a major reduction in effective capacity. This was demonstrated during the 1982/83 rainy season when most of the capacity was filled by a single storm.

The excavated basin in the old salt evaporation pond area (No. 1) has an excavated capacity of 496,000 cu. yds. (308 ac. ft.) for a surface area of about 50 acres. The installation cost of this basin was \$1,470,000 or about \$2.96 per cubic yard of excavated capacity provided.

It is estimated that this excavated basin will cause deposition of most of the sand particles and 20 percent of the silt and clay particles entering Upper Newport Bay. On this basis about 15,500 tons of the sediment inflow to Upper Newport Bay with the in-channel basins installed will be deposited, of which about 75 percent will be silt and clay particles.

With the Early Action and Interim Plan, the estimated costs of downstream sediment removal will be:

Channel deposition (other than in basins) - 49,900 tons at \$3 per ton	\$149,700
Deposition in basins (including 21,700 tons that would normally deposit in this channel reach) 46,700 tons at \$3 per ton	140,100
Deposition in excavated basin in Upper Newport Bay - 15,500 tons at \$7.50 per ton	116,250
Balance of sediment inflow to Newport Bay - 45,000 tons (60,500-15,500) at \$7.50 per ton	337,500
	-----
Average Annual Sediment Removal Costs	\$743,550

4. Alternative 4 - Install Three Additional In-Channel Basins  
to Supplement the Early Action and Interim  
Plan Facilities

This alternative includes the installation of three additional in-channel sedimentation basins to provide 272,600 cubic yards (169 acre-feet) of storage capacity to supplement the two in-channel basins included in the Early Action and Interim Plan. The locations for these additional basins are shown on Figure 9 (Nos. 4, 5, and 6).

Basin Number 4 would begin immediately upstream from the sewer line crossing into the Michelson Treatment Plant and extend to Michelson Drive. The San Joaquin Channel will enter this basin at its junction with San Diego Creek.

It would have a length of 3180 feet and have a design similar to the two lower basins except that no 30-foot benches would be provided. The estimated capacity for sediment accumulation is 168,600 cu. yds. (104 acre-feet). The total estimated cost to install this basin is \$1,102,000 or about \$6.50 per cubic yard of storage capacity provided.

Basin Number 5 may be located between the San Diego Freeway and Main Street. The channel has a bottom width of 140 feet and side slopes 1 1/2:1 in this reach. Benches 15 feet wide would be provided on each side. It could have a length of about 1480 feet and a capacity of 31,500 cu. yds. (20 acre-feet). The total estimated cost to install this basin is \$366,000, or about \$11.60 per cubic yard of storage capacity provided.

Basin Number 6 may be located between Main Street and a telephone cable crossing. This channel reach has a bottom width of 140 feet and side slopes 1 1/2:1. Benches 15 feet wide are provided on each side to assure slope stability with the greater depths. It could have a length of 3020 feet and a capacity of 72,800 cu. yds. (45 acre-feet). The total estimated cost to install this basin is \$532,000 or about \$7.30 per cubic yard of storage capacity provided.

The reach of San Diego Creek between MacArthur Boulevard and Jamboree Road was considered but there are numerous utility crossings which make it undesirable.

These three additional in-channel basins will provide additional sediment storage capacity of 272,800 cubic yards (169 acre-feet) at a cost of \$2,000,000 (\$7.33 per cubic yard).

These basins, in combination with the two installed with the Early Action and Interim Plan, will provide trap efficiencies greater than would be obtained with the two alone as shown on Table 9. Also, when about half of the combined capacities are filled with deposited materials, the combined basins will continue to trap the sand particles and a portion of the silt particles.

Tables 8 and 9 indicate that the five basins included in alternative 4 will trap about 31 percent more sediment than the two basins installed with the EA & IP (32,800 tons vs 25,000 tons).

However, these analyses assume the maintenance of full trap efficiencies of the basins during the entire duration of storms of all return periods.

With the limited combined capacity of the two basins installed with the EA & IP, the trap efficiency is greatly reduced with relatively small amounts of sediment accumulation. During a storm such as occurred during the 1982/1983 season, the basins became filled to about 50 percent of their total capacity causing a radical reduction in trap efficiency. Undoubtedly a large portion

TABLE 9

AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
WITH IN-CHANNEL BASINS NO. 2, 3, 4, 5, & 6 INSTALLED  
ALTERNATIVE NO. 4 1/  
(EXISTING CONDITIONS) 2/

	Total Tons	Particle Size Distribution Tons			
		Clay	Silt	Fine Sand	Coarse Sand
Sediment Produced					
Upslope Areas	118,300	36,600	41,400	28,600	11,700
Channel Erosion	<u>38,800</u>	<u>400</u>	<u>200</u>	<u>31,400</u>	<u>6,500</u>
Total Sediment Produced	157,100	37,000	41,600	60,300	18,200
Deposition					
In Basins	59,300	--	29,300	25,000	5,000
Add'l Channel Deposition	<u>45,100</u>	<u>-900</u>	<u>--</u>	<u>33,700</u>	<u>12,300</u>
Total Deposition	104,400	-900	29,300	58,700	17,300
Sediment Delivered to Upper Newport Bay					
With Basins	52,700	37,900	12,300	1,600	900
Without Basins	85,500	37,600	33,400	13,600	900
Reduction with Basins	32,800	-300	21,100	12,000	--

1/ The recommended plan.

2/ For conditions prior to installation of the Early Action and Interim Plan.

of the sediment in the stormflows passed through to Upper Newport Bay which would have been trapped by the basins if the trap efficiency had been maintained throughout the storm.

The three additional basins that will be provided with alternative 4 will maintain high trap efficiencies during the full durations of major storms or when the basins become partially filled by progressive accumulation.

The combined capacities of all five in-channel basins is 554 cubic yards (344 acre-feet). The estimated average annual sediment inflow into Upper Newport Bay is 85,500 tons (53 acre-feet). It is indicated that about 27,400 tons of this sediment would be trapped by the basins. In addition, about 34,000 tons of sand particles normally deposit in the reach between the junction of San Diego Creek with Peters Canyon Wash and Jamboree Road. This would indicate that about 61,400 tons of sediment would deposit in the basins on an average annual basis and that about half of the total basin capacities would be filled every five years. This would require periodic removal so that a reasonable trap efficiency could be maintained. Major stormflows would deposit much larger amounts of sediment than average and may require more frequent sediment removal in some periods than others.

This consideration of alternatives has indicated that upstream sediment control measures can be installed to remove 100 percent of the sand particles and over 50 percent of the silt particles. The remaining silt and clay particles will continue to be discharged into Upper Newport Bay. On an average annual basis about 53,000 tons of silt and clay particles will enter the Bay.

The excavated basin in Upper Newport Bay is estimated to trap about 20 percent of the silt and clay particles and 100 percent of the sand particles entering the Bay.



The estimated average annual maintenance costs to remove sediment deposited in the channel system, the basins and Upper Newport Bay with this alternative are summarized as follows:

Channel deposition other than in basins - 45,100 tons at \$3 per ton	\$135,300
Deposition in basins that would have deposited in channel reach - 26,500 tons at \$3 per ton	79,500
Additional deposition in basins that would have flowed into Upper Newport Bay - 32,800 tons at \$3 per ton	98,400
Sediment trapped in excavated basin in Upper Newport Bay - 14,000 tons at \$7.50 per ton	105,000
Additional sediment deposited in Upper Newport Bay - 38,700 tons (52,700-14,000) at \$7.50 per ton	290,250
	-----
Total Average Annual Sediment Removal Costs	\$708,450

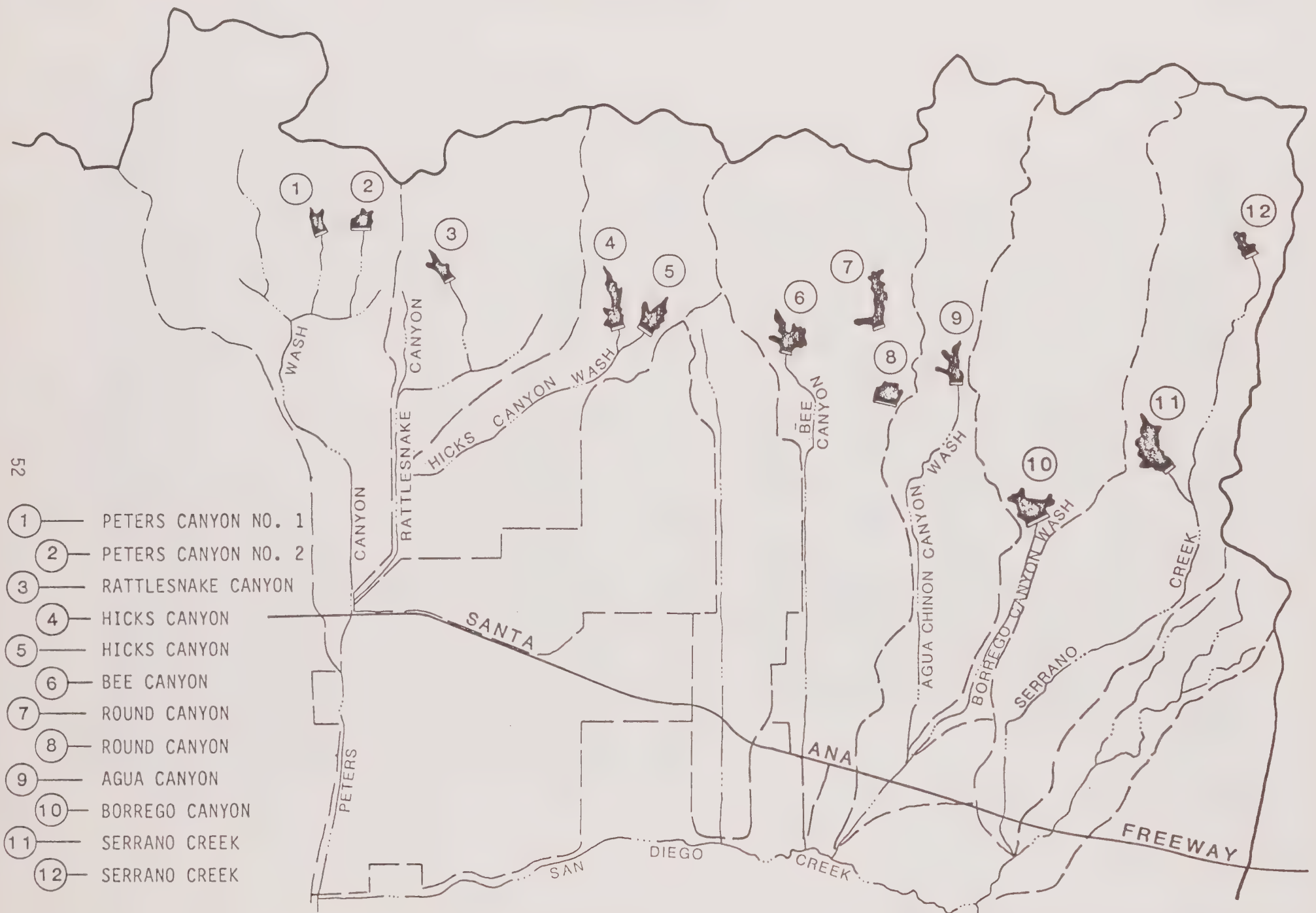
5. Alternative 5 - Installation of Foothill Basins to Obtain Floodwater Retarding Effects and Sedimentation Control

As is shown in Table 2 and Figure 2, the foothill area of the watershed produces about 66 percent of the sediment from about 28 percent of the total watershed area under existing conditions. A portion of this sediment produced in the foothill area may be trapped by foothill sedimentation basins and kept from entering the channel system in the valley area. The locations of 12 possible foothill basins are shown on Figure 12.

To be effective in trapping significant amounts of sediment, particularly the finer particles, the basins should have fairly large capacities to provide retention time for the flood flows with consequent reduction of velocities.

This requirement indicates the desirability of developing dual-purpose reservoirs for floodwater retarding and sediment control. Reservoirs with capacities to provide effective floodwater retarding will provide the characteristics that will be effective in trapping sediment particles.

For this analysis of floodwater retarding possibilities for dam sites within the foothill area, it has been assumed that with reservoir floodwater retarding capacities equal to the volumes of the 3-hour duration 100-year return period storm runoff that the estimated outflow rates from the principal spillways from the dams could be controlled to one-third of the estimated peak flows for



**SAN DIEGO CREEK WATERSHED  
FOOTHILL SEDIMENTATION BASINS**



**Boyle Engineering Corporation**  
consulting engineers / architects

the 24-hour duration 100-year return period storm. This appears conservative on the basis of studies made for a floodwater retarding reservoir on the Borrego Canyon Wash watershed. The reconnaissance-type site information available for these dam sites indicates that these capacities could be provided.

In addition to environmental benefits, a major economic justification for the installation of these foothill basins will be the reduced costs for downstream channel improvements. These reduced costs will be based on the reduced channel capacity requirements caused by floodwater retarding. The reductions will be greatest through the drainage areas immediately downstream from the reservoirs, ranging from 90 to 95 percent of the unretarded peak flows for the 3-hour duration 100-year return period storm. As additional uncontrolled flood flows from tributary drainage areas enter the channels the proportionate reductions from those that would occur without floodwater retarding will be progressively less.

Detention of runoff from future development in the areas downstream from the foothill basins with the use of on-site basins would reduce the inflows from tributaries and cause further reductions in peak flows. These combined reductions in peak flows would reduce channel erosion in unstabilized channels, reduce the amounts of sediment transported through the drainage area and increase the effectiveness of downstream in-channel sedimentation basins.

Costs to install these foothill basins were estimated on the basis of estimates that were made for previous studies of the basins. The estimated total cost for these 12 basins, excluding costs for land rights and relocation of utilities, is \$10,878,200.

These 12 reservoirs have a combined total capacity of 1985 acre-feet to emergency spillway crest elevations including 315 acre-feet (508,000 cubic yards) of capacity for sediment accumulation. The estimated cost per acre-foot of total capacity is \$5,480. If all costs were allocated to sediment storage capacity, the installation cost per acre-foot of capacity provided would be about \$34,500 (\$21.40 per cubic yard). These costs will be considerably larger when the costs for land rights and relocation of utilities are included.

It is apparent that these reservoirs cannot be economically justified as single-purpose reservoirs for sediment accumulation.

However, it is probable that at least some of them can be economically justified by the reduction in channel improvement costs downstream because of the reduced capacity requirements from floodwater retarding.

On an average annual basis, it is estimated that 33,000 tons of sediment would be deposited in these 12 basins. Of this amount, 17,700 tons are silt and clay particles and 15,300 tons are sand

particles. The trapped sand particles will not represent a net reduction of sediment inflow to Upper Newport Bay because the flood flows will tend to reestablish a full load of these particle sizes by channel erosion unless the channels are stabilized.

The trapped silt and clay particles will represent a net reduction of sediment inflow to Upper Newport Bay as their removal from the flood flows will not cause replacement by other silt and clay particles. The flood flows do not have such limits on their capacities to transport these smaller particles.

The total estimated average annual sediment inflow to Upper Newport Bay under existing conditions is 85,500 tons, of which 82 percent is silt and clay particles or 71,000 tons. The 17,700 tons of silt and clay particles trapped in the foothill basins would represent a 25 percent reduction in the amounts of these particle sizes entering the bay. (Table 10).

Maintenance operations would require the average annual removal of 33,030 tons of all particle sizes from the basins. Channel erosion would replace 15,320 tons of sand particles which would be redeposited in channel reaches with flatter gradients or in Upper Newport Bay. A second maintenance cost would be incurred for the removal of this channel eroded and redeposited material assuming downstream channels are not stabilized.

The estimated average annual costs to remove and dispose of all sediment deposited in the foothill basins, the channels and Newport Bay assuming downstream channels are not stabilized, are summarized as follows:

Deposition in the foothill basins - 33,030 tons at \$3 per ton	\$ 99,000
Channel deposition - 71,600 tons at \$3 per ton	214,800
Deposition in Newport Bay - 67,800 tons at \$7.50 per ton	508,500
	-----
	\$822,300

#### 6. Alternative 6 - Combined Installation of Alternatives 4 and 5

This alternative provides for the installation of the Early Action and Interim Control Plan along with three additional in-channel basins; and the installation of the 12 foothill basins.

Table 11 tabulates the effects of this combination of control measures in reducing the sediment inflow to Upper Newport Bay. The foothill basins would trap an estimated 17,700 tons of silt and clay particles which would reduce the silt and clay content of the flood flows by this amount. The sediment inflow at the



TABLE 10  
AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
WITH INSTALLATION OF 12 FOOTHILL BASINS  
ALTERNATIVE NO. 5  
(EXISTING CONDITIONS) 1/

	Total Tons	Particle Size Distribution Tons			
		Clay	Silt	Fine Sand	Coarse Sand
Sediment Produced					
Upslope Areas	118,300	36,600	41,400	28,600	11,700
Channel Erosion	<u>38,800</u>	<u>400</u>	<u>200</u>	<u>31,700</u>	<u>6,500</u>
Total Sediment Produced	157,100	37,000	41,600	60,300	18,200
Deposition					
In Foothill Basins (Silt & Clay only)	17,700	900	16,800	--	--
Channel Deposition	<u>71,600</u>	<u>-600</u>	<u>8,200</u>	<u>46,700</u>	<u>17,300</u>
Total Deposition	89,300	300	25,000	46,700	17,300
Sediment Delivered to Upper Newport Bay					
With Foothill Basins	67,800	36,700	16,600	13,600	900
W/o Foothill Basins	85,500	37,600	33,400	13,600	900
Reduction with Basins	17,700	900	16,800	--	--

1/ For conditions prior to installation of the Early Action and Interim Plan.

TABLE 11

AVERAGE ANNUAL SEDIMENT PRODUCTION AND DEPOSITION  
COMBINED INSTALLATION OF ALTERNATIVES 4 AND 5  
(EXISTING CONDITIONS) 1/

	Total Tons	Particle Size Distribution Tons			
		Clay	Silt	Fine Sand	Coarse Sand
Sediment Produced					
Upslope Areas	118,300	36,600	41,400	28,600	11,700
Channel Erosion	<u>38,800</u>	<u>400</u>	<u>200</u>	<u>31,700</u>	<u>6,500</u>
Total Sediment Produced	157,100	37,000	41,600	60,300	18,200
Deposition					
Foothill Basins	17,700	900	16,800	--	--
In-Channel Basins	46,400	--	16,400	25,000	5,000
Add'l Channel Deposition	<u>45,100</u>	<u>-900</u>	<u>--</u>	<u>33,700</u>	<u>12,300</u>
Total Deposition	109,200	--	33,200	58,700	17,300
Sediment Delivered to Upper Newport Bay					
W/All Measures Installed	47,900	37,000	8,400	1,600	900
W/O Measures Installed	85,500	37,600	33,400	13,600	900
Reduction W/Measures	37,600	600	25,000	12,000	--

1/ For conditions prior to the installation of the Early Action and Interim Plan.

junction with Peters Canyon Wash would be reduced to 73,800 tons (91,500-17,700). A total of 46,400 tons would be trapped by the five basins. This amount includes 26,500 tons that would normally be deposited in the channel section. The net reduction of sediment inflow to Upper Newport Bay caused by the in-channel basins is 19,900 tons (46,400-26,500). The combined total reduction of sediment inflow to Upper Newport Bay caused by this combination of measures is 37,600 tons (foothill basins-17,700 tons plus in-channel basins-19,900 tons).

The five in-channel basins without the foothill basins are estimated to trap 32,800 tons of sediment that would not have been deposited in the channels normally. The additional 12,900 tons trapped is due to the increased silt load in the flood flows subject to trapping without the foothill basins.

The reduction in outflow to Upper Newport Bay is reduced by only 4,800 tons with the installation of the foothill basins.

The estimated average annual costs to remove and dispose of all sediment deposited in the foothill basins, the channel sections, the in-channel basins and Newport bay are summarized as follows:

Deposition in foothill basins - 33,030 tons at \$3 per ton	\$ 99,000
Channel deposition outside basin area - 45,100 tons at \$3 per ton	135,300
Normal channel deposition which is deposited in basin - 26,500 tons at \$3 per ton	79,500
Additional deposition caused by basins 19,900 tons at \$3 per ton	59,700
Sediment deposited in excavated basin within Upper Bay - 11,600 tons at \$7.50 per ton	87,000
Additional sediment entering Newport Bay - 36,300 tons (47,900 - 11,600) at \$7.50 per ton	272,250
Total annual sediment removal costs	<u>\$732,750</u>

## 7. Summary - Comparison of Alternatives

Table 12 summarizes the deposition characteristics and costs that are associated with the six alternative management systems under existing conditions. The average annual costs for removal of sediment include the costs for the removal of sediment that occurs in channel reaches on the flatter gradients without a project. This basis for comparison is used as the in-channel basins accumulate sediment that would have deposited in the channel without the basins. The reduced costs for sediment removal caused by each alternative is the difference between the estimated costs with the alternative installed and those required with the "No Project" alternative.

In the table, it has been assumed that all of the sediment inflow to Upper Newport Bay will require removal from some location within the Bay eventually. Investigations have indicated that a very small percentage of sediment inflow is transported through the Bay to the ocean.

These analyses have indicated that Alternative 4 will provide the most cost effective structural measures to be installed primarily for sediment control. The three additional in-channel basins supplementing the two installed under the Interim Plan will assure more effective trap efficiencies over a wider range of conditions than would be obtained with Alternative 3.

The progressive application of good land management practices and the installation of foothill basins and channel stabilization measures will further reduce sediment production and transport causing these in-channel basins to be more effective in reducing sediment inflow to Upper Newport Bay.

The total estimated capital investment cost for installing Alternative 4 is \$2,000,000 in addition to that spent for the installation of the Early Action and Interim Plan. The average annual costs to remove sediment from the channels and basins will increase by \$98,400. However, removing the sediment from the basins at \$3 per ton is much less expensive than from the bay at \$7.50 to \$10.00 per ton. The total cost of removing all sediment produced from upslope areas and channel erosion would be reduced by \$147,600 (\$856,050-\$708,450).

Sediment production from agricultural and construction areas will be progressively reduced with the more intensive application of best management practices (BMPs). These reductions will cause less inflow of silt and clay particles to Upper Newport Bay and less deposition of sand particles in the basins and channel reaches. Consequently, the costs to remove these materials will be reduced.

Subdivision developments in the valley areas could be required to provide floodwater retarding basins to reduce outflows to a specified amount. These basins may reduce the downstream flows



TABLE 12  
SUMMARY OF DEPOSITION CHARACTERISTICS AND COSTS  
ALTERNATIVE SEDIMENTATION CONTROL SYSTEMS  
(EXISTING CONDITIONS)

ALTERNATIVE	SEDIMENT PRODUCTION			UPSTREAM DEPOSITION			UPSTREAM MAINTENANCE COSTS <sup>1/</sup>			SEDIMENT TO UNB			(13) TOTAL Ave. Ann. Sediment Removal Costs (Dollars) (9) + (12)
	(1) Upslope Areas (Cu. Yds.)	(2) Channel Erosion (Cu. Yds.)	(3) Total Sediment Produced (Cu. Yds.) (1)+(2)	(4) Normal Channel Reaches (Cu. Yds.)	(5) In-Chan'l Basins (Add'l) (Cu. Yds.)	(6) Total Depo- sition (Cu. Yds.) (4)+(5)	(7) Normal Depo- sition (Dollars) (4)x\$3 <sup>00</sup>	(8) Add'l In-Chan'l Basins (Dollars) (5)x\$3 <sup>00</sup>	(9) Total Upstream Costs (Dollars) (7) + (8)	(10) Upstream Install'n Costs (Dollars)	(11) Ave. Ann. Inflow (Cu. Yds.) (3) - (6)	(12) Ave. Ann. Removal Costs (Dollars) (11)x\$7.50	
1. No Project	118,300	38,800	157,100	71,600	-	71,600	214,800	-	214,800	None	85,500	641,250	856,050
2. Channel Stabilization Measures Only	118,300	-	118,300	38,900	-	38,900	116,700	-	116,700	Not Estm'd	79,400	595,500	712,200
3. Early Action and Interim Control Plan	118,300	38,800	157,100	71,600	25,000	96,600	214,800	75,000	289,800	2,230,000 <sup>3/</sup>	60,500	453,750	743,550
4. Alternative 3 plus Three Add'l Basins	118,300	38,800	157,100	71,600	32,800	104,400	214,800	98,400	313,200	4,230,000 <sup>3/</sup>	52,700	395,250	708,450
5. Foothill Basins	118,300	38,800	157,100	71,600	15,300 <sup>4/</sup> 17,700	15,300 89,300	214,800	99,000	313,800	10,878,200 <sup>5/</sup>	67,800	508,500	822,300
6. Combined Installation Alternatives 4 & 5	118,300	38,800	157,100	71,600	15,300 <sup>4/</sup> 37,600	15,300 109,200	214,800	158,700	373,500	15,108,200 <sup>3/5/</sup>	47,900	359,250	732,750

NOTE: Sedimentation basins in Upper Newport Bay are estimated to cost \$3,525,000 in addition to the \$1,470,000 spent to install the excavated basin included as a part of the Early Action and Interim Control Plan.

- 1/ Estimated to cost \$3.00 per cu.yd. for upstream sediment removal.
- 2/ Estimated to cost \$7.50 per cu.yd. to remove sediment deposited in Newport Bay.
- 3/ Excluding the \$1,470,000 cost to install the excavated basin in the old salt evaporation pond area.
- 4/ Sand particles trapped in foothill basins assumed to be replaced by channel erosion.
- 5/ Excluding costs for land rights and relocation of utilities.



sufficiently to reduce channel erosion significantly, especially if installed in tandem with the foothill basins.

In Santa Barbara County, this concept has been used to reduce peak runoff from new developments so that existing downstream channels would contain the increased runoff generated by the developments. The criteria used for the design of such basins are to provide capacity equal to the estimated volume of runoff from the 25-year return period 24-hour duration storm for the developed drainage area to the basin and to limit the outflow to 0.07 cfs per acre of drainage area.

This concept was considered for areas of various sizes in the San Diego Creek watershed.

For a one square mile drainage area, the average annual reduction in channel erosion potential immediately downstream from the site was estimated to be 60 percent. An area of about 33 acres would be required for the basin. This basin area may be incorporated into the developed area as a park or other community purposes. Excavated materials could probably be incorporated in the grading plan for the development.

On a larger scale, the effects of basins installed on 9.82 square miles of area at the lower end of the San Diego Creek watershed segment above Sand Canyon Avenue, with a total drainage area of 40.20 square miles, were considered. The estimated average annual reduction in channel erosion potential was 10 percent at this location as a result of the reduced peak flows caused by the basins.

The maximum channel erosion reduction that could be obtained in the watershed would be achieved by incorporating retarding basins into the development plans for the 31.8 square miles of agricultural and open space that are anticipated to be ultimately converted to urban uses together with installing the 12 foot-hill basins discussed previously.

The 12 foothill basins would control the runoff from a combined area of 16.42 square miles and have combined controlled outflow of 1480 cfs.

The valley area of 31.8 square miles with retarding basins would have a combined outflow of 1425 cfs on the basis of outflow rates of 0.07 cfs per acre. This assumes that the basins could be located so that the outflows would enter directly into tributaries of the primary channel system and would not pass through other basins in series.

It is estimated that this combination of foothill and valley basins would reduce the peak flows for the 100-year return period 24-hour duration storm at the inlet to Upper Newport Bay from 27,000 cfs to about 18,600 cfs. The channel erosion potential would be reduced about 23 percent.

The costs to install these valley basins are dependent on the specific development plans.

These basins would not reduce upslope sediment production but would tend to trap the sand and coarse sediment particles in the storm flows. However, as these basins would be installed concurrent with urban development, the sediment production from these areas would be greatly reduced as the development matures. They could be used effectively to trap the sediment production from construction areas as the developments occur.

These basins would reduce the cost of channel improvements immediately downstream from the basin locations because of smaller channel capacity requirements. However, they would cause progressively smaller reductions in peak flows as the runoff from other uncontrolled drainage areas entered the streamflows. Their effects would be similar to those of the foothill basins. If installed in areas immediately downstream from the foothill basins, they would tend to extend the reduced channel capacity requirements caused by the foothill basins into the lower channel reaches.

The continued inflow of silt and clay particles into Upper Newport Bay will require additional excavated basins in the Upper Bay, or an enlargement of the basin installed with the Early Action Plan, to localize deposition and prevent the progressive increase of sediment deposition in the lower portions of the Bay. Localizing the deposition will also facilitate sediment removal. These basins could be located in the area between The Narrows and the old salt works dike. Excavated basins similar to the one located in Upper Bay immediately downstream from Jamboree Road would provide deposition characteristics similar to those provided historically before this area became filled with sediment.

The locations, configurations and capacities must be determined to effectively cause sediment deposition and to be compatible with the restoration objectives of the State Department of Fish and Game for this area. These plans should be developed by the Department of Fish and Game.

The concept of two circular basins with surface areas of about 27 acres, depths to -4.0 feet mean sea level, side slopes of 10:1, and storage capacities of about 94 acre-feet each, would require about 470,000 cubic yards of excavation. The estimated installation cost for these two excavated basins would be about \$3,525,000 on the basis of \$7.50 per cubic yard. The final plan determined as appropriate by the Department of Fish and Game may vary considerably from this estimated cost.

Under conditions of ultimate development with the installation of channel stabilization measures, reduced sediment production from urban areas, and the probable installation of at least some of the foothill basins, the sediment transported by the stormflows will



be greatly reduced. This will result in reduced sediment deposition in the channels and basins, and in Upper Newport Bay. The costs for sediment removal will be greatly reduced and more effective management of the Upper Newport Bay Ecological Reserve will be possible. The measures installed with Alternative 4 will remain effective but will require sediment removal less frequently.

Under conditions of ultimate development and "No Project", the average annual sediment inflow to Upper Newport Bay is estimated as 64,500 tons and channel deposition as 88,700 tons.

Under conditions of ultimate development with Alternative 4 installed but without channel stabilization measures, the total upstream deposition is estimated as 128,900 tons. The estimated average annual cost to remove sediment deposited upstream would be \$386,700 (128,900 tons at \$3 per ton) and to remove that entering Newport Bay \$182,250 (24,300 tons at \$7.50 per ton) for a total of \$568,950.

With all channels stabilized under ultimate conditions, the total sediment production is estimated as 62,500 cubic yards. With Alternative 4 installed, the total upstream deposition is estimated as 38,200 cubic yards. The estimated average annual cost to remove sediment deposited upstream would be \$114,600 (38,200 tons at \$3 per ton) and to remove that entering Newport Bay \$182,250 (24,300 tons at \$7.50 per ton) for a total of \$296,850.

With all channels stabilized under ultimate conditions, the average annual maintenance costs for removing sediment would be reduced by \$272,100 (\$568,950-\$296,850) with Alternative 4 installed.

## B. Environmental Assessment

The Environmental Assessment of Alternative Sedimentation Control Plans was prepared by Phillips Brandt Reddick, Inc., and was included as Appendix A in the General Audience Report, Stormflow Sedimentation Control Alternatives (Task III-E)

Following are summarized the anticipated overall environmental impacts that would result from the implementation of each of the Alternatives considered.

### 1. Alternative 1 - No Project

No adverse short-term environmental impacts would occur if sedimentation control measures were not implemented. However, some of the longer term environmental impacts could be considered of major significance. Due to sediment deposition in the Upper Bay (landform and hydrology impacts) the sensitive biological habitat of the Upper Bay would eventually be transformed. This would have significant impacts on the ecological reserve and the aesthetics of the Upper Bay. The periodic

traffic, air quality and noise impacts are considered moderate since they would occur in several areas in the watershed.

2. Alternative 2 - Channel Stabilization Measures Only

This alternative would result in moderate environmental impacts, primarily related to construction-related impacts which would necessarily occur throughout the watershed and along all or most unimproved channels. Long-term impacts would result from loss of open space and wildlife habitats. Periodic environmental impacts would also be caused by maintenance operations.

3. Alternative 3 - Control Measures Included in the  
Early Action and Interim Plan

This alternative will have moderate construction-related adverse impacts. Long-term adverse impacts of this alternative should be minimal. Most of the long-term effects will be beneficial to the water quality and biological resources in the Upper Newport Bay.

4. Alternative 4 - Alternative 3 in Combination with  
Three Additional In-Channel Basins

The adverse impacts of this alternative are considered to be only slightly increased over those for Alternative 3. Beneficial impacts will be increased because of more effective control of sediment.

5. Alternative 5 - Installation of Twelve Foothill Basins

The overall short-term impact from this alternative would be major due to construction occurring throughout the foothills. Since the basins would be located in twelve major drainage courses of the foothills, aesthetic and biological impacts would be the most significant direct impacts. Indirect impacts from traffic volumes, exhaust emissions and noise are considered significant since the proposed basins are scattered across the foothills and these impacts would therefore affect roads and land uses throughout the watershed.

Maintenance operations would result in periodic environmental impacts throughout the foothill environment. The major long-term impact of this alternative would be the loss of open space required for installation of the basins.

6. Alternative 6 - Combined Installation of Alternatives 4 and 5

The overall short-term impacts of this alternative would be major since construction impacts would occur throughout the foothills and in the lower San Diego Creek channel and Upper Newport Bay. The overall impact would be the combined impacts of Alternatives 4 and 5. A generic list of mitigation

measures that could be employed to reduce impacts of sedimentation control systems has been developed as part of this assessment.

## 7. Resource Management System

Resource Management Systems which reduce erosion and sediment inflow to the Upper Newport Bay have been developed for construction sites and agricultural areas in the watershed in Technical Memoranda for Task 8015.02 (Agricultural Activities Interim Sediment Control Plan) and Task 8015.03 (Construction Activities Best Management Practices Plan). Most of the best management practices (BMPs) recommended in these technical memoranda are general, rather than site specific.

Consistent use of additional BMPs is an essential part of the comprehensive sediment control plan, but will not by itself adequately protect the Bay.

## 8. Conclusions

In conclusion, the most environmentally sound approach to protect the Bay from sedimentation is a comprehensive program that includes in-channel sedimentation basins, channel stabilization measures, foothill basins, and the use of additional best management practices on agricultural and construction areas. The installation of additional excavated basin capacity within the Upper Bay would facilitate the management of sediment that will continue to enter the Bay. The installation of additional in-channel basins will reduce the existing average annual sediment inflow to the Bay by approximately 38 percent, which represents a 9 percent increase over the sediment reduction expected from the EA & IP facilities alone. Additional deposition of 14,000 cubic yards would occur within the excavated basin in the Upper Bay. The adverse environmental impacts of this alternative would be greater than those of EA & IP facilities alone, but would be confined mostly in the San Diego Creek channel above the EA & IP area and downstream of the confluence of San Diego Creek and Peters Canyon Wash.

Further documentation of the potential environmental impacts upon the San Diego Creek channel area and the bay resulting from this alternative should be prepared. The primary environmental issues include the importance of the creek as a wildlife habitat and corridor and the short-term impacts of disturbing the creekbed vegetation for construction and for periodic maintenance. These issues should be weighed carefully against the potential improvement in water quality and the enhancement of biological resources in the Bay, resulting from reduced sedimentation.

In addition, Boyle Engineering has suggested that further consideration be given to the installation of two additional excavated basins in Upper Newport Bay which could effectively

trap most (90%) of the silt and clay particles before they enter the Lower Bay system. As described in the Technical Memorandum for Tasks III-B and III C, there are significant environmental issues associated with the installation of these basins, primarily the environmental significance of the marsh habitat that would be removed. This long-term impact would have to be weighed against the benefits to the biological resources in Upper and Lower Newport Bay that would result from the installation and continuing operation of these additional basins. Future environmental documentation would provide a mechanism for this evaluation.

While the alternative of implementing resource management systems (both agricultural and construction) throughout the watershed has not been thoroughly assessed because of limited information regarding their effectiveness or extent of application, reduction of erosion and sedimentation at the source should supplement any structural system for removing sediment before it enters the Bay. Such an approach would result in positive environmental impacts by preventing siltation and water quality impacts in stream channels and Upper Newport Bay. In the case of agricultural lands, an additional economic benefit would result by retaining topsoil for continued crop production. Construction sedimentation measures are required by local jurisdictions in the watershed as part of grading ordinances.



## V. RECOMMENDED PLAN

The recommended plan consists of land management practices to reduce sediment at its sources, and structural measures to localize sediment deposition and facilitate its management.

### PLAN ELEMENTS

- A. Improve agricultural land management practices.
- B. Improve construction land management practices.
- C. Install and maintain in-channel basins.
- D. Install and maintain in-Bay basins. (Figure 9)
- E. Stabilize channels within developing areas and dedicated rights-of-way.
- F. Install and maintain foothill basins. (Figure 12)
- G. Monitor sediment delivery to Newport Bay and transport through the Bay.

#### A. Improve Agricultural Land Management Practices

Agricultural lands have been identified as producing approximately 42 percent of the sediment delivered to Upper Newport Bay through direct rainfall and drainage across such lands and through unstabilized drainage channels. Ultimately most of these lands will be urbanized, resulting in a substantial reduction in sediment production from this source. Until these lands are developed, land management practices will decrease sediment production and thus reduce costs of sediment removal from downstream channels, sedimentation basins, and Newport Bay. Downstream structural measures will still be needed to manage the sediment produced, but maintenance costs will be reduced as the effectiveness of land management practices is improved.

##### 1. Current Application of Best Management Practices (BMPs)

At the present time, Best Management Practices (BMPs) are in place in varying degrees on agricultural land throughout the watershed. In the high erosion hazard areas in the foothills as identified on the SCS "Erosion Hazard Map", each field has between four and seven BMPs applied with an average of about six. On the moderate erosion hazard areas in the foothills, each field has between three and seven BMPs applied, with an average of about five. These areas are used almost entirely for the production of oranges, lemons and avocados. About one-half of the area is planted on the contour and about 90 percent is irrigated with drip irrigation

systems. Other BMPs in general use are crop residue use, cover and green manure crops, grade stabilization structures, grassed waterways and terraces.

In the valley area with less erosion hazard, each field has between one and seven BMPs applied with an average of more than three. BMPs in general use are crop residue use, permanent furrows in orchards, irrigation water management including drip irrigation, grade stabilization structures, grassed waterways and floodwater diversions. Most of the orchards in the valley area have heavy canopy which provides protection from direct rainfall impact.

## 2. Agricultural Activities Interim Sedimentation Control Plan

Orange County Environmental Management Agency (OCEMA), in March, 1981, completed a study report entitled, "Newport Bay Watershed: Agricultural Activities Interim Sedimentation Control Plan" which identifies agricultural best management practices (BMPs) and recommends a management plan.

In the development of this report, an inventory of BMPs now being applied on each field was made. The effectiveness of these practices was evaluated and problem areas requiring additional BMPs were identified.

## 3. 208 Areawide Waste Treatment Management Plan Amendments

The 208 Areawide Waste Treatment Management Plan Amendments prepared by the Southern California Association of Governments, dated September, 1982, and approved by EPA, includes summaries of findings and recommended actions to control sediment production by agricultural and construction activities. A copy of those parts of this Amendment relating to agricultural activities are included in Appendix A.

The amendment relating to agricultural activities recommends that the State Water Resources Control Board (CSWRCB) consider designating Orange County and the cities of Irvine and Newport Beach as management agencies in the Newport Bay Watershed. These management agencies through local ordinances would encourage and enforce the implementation of a management strategy to mitigate sedimentation in Upper Newport Bay. This would include the development of resource conservation plans (RCPs) and the implementation of these plans to obtain accelerated application of best management practices (BMPs) on agricultural areas.

- a. Orange County Board of Supervisors, on April 12, 1983, adopted Resolution No. 83-534 to implement the recommendations in the SCAG 208 Amendment pertaining to preparation and implementation of Resource Conservation Plans (RCPs) and annual reporting and inspection. (Appendix B)

- b. The city council of the City of Irvine adopted resolution no. 81-113 on November 24, 1981 and the city council of the City of Newport Beach adopted resolution no. 11083 on November 9, 1981 supporting the 208 Amendment (Appendices C and D).
- c. The City of Irvine has drafted an ordinance to implement the recommendations in the SCAG 208 Amendment pertaining to preparation of RCPs and annual reporting on and inspection of the implementation of BMPs.
- d. The 208 Amendment specifies that if the County/City is not successful in implementing an effective agricultural sedimentation control strategy, the CSWRCB shall withdraw its designation of the County/City as a management agency. Consequently, it may choose to establish limitations on the amount of sediment discharged from specific water conveyance structures to the waters of the state.

#### 4. Recommendations

- a. The City of Irvine and County of Orange adopt ordinances requiring landowners to prepare RCPs. The ordinances should give first priority to preparation of RCPs for areas with high erosion hazard areas as identified on the SCS "Erosion Hazard Map". RCPs for these areas should be submitted by November 1983 and implemented by November 1984.

RCPs for the other remaining areas should be submitted by November 1984 and implemented by November 1985.

The ordinances should require landowners to submit annual reports on the progress of RCP preparation and implementation.

- b. The RCPs be prepared by the USDA, Soil Conservation Service (SCS), or a registered Agricultural Engineer. The RCPs should include:
  - (1) A land use map indicating fields by number for identification.
  - (2) Identification of soil types and slope characteristics of each field which would indicate the inherent erosion potential.
  - (3) A list of BMPs presently in place.
  - (4) A narrative statement of the erosion problems, if any, in each of the fields.
  - (5) In preparing the RCPs, give priority to providing solutions to the problem areas identified in the OCEMA Report.

This report specifies the following BMPs for implementation to control sediment production from these areas:

1. Develop access roads in foothill orchards along the ridge and closer to the contour to provide access, safety and erosion control. Provide waterways adjacent to the roads.
2. Grass tail ditches from nontillage orchards in recognized problem areas.
3. Mulch old valencia orange orchards with slopes greater than 1-1/2 percent in recognized problem areas only.
4. Switch orchards, especially on the steeper slopes, to drip irrigation where economically feasible.
5. Install filter strips around low ends of bare fields.
6. Construct valley sediment control basins rather than individual field basins.
7. Employ, where possible, double-cropping in the winter with an associated change in the rotation of the crops.
8. Provide erosion susceptible winter-bare fields with temporary debris basins.
9. Install drop boxes and/or chutes with protective lining on fields where the present means of conveyance to the drainage ditch is producing erosion.

In addition, priority should also be given to providing BMPs which will be most effective in reducing sediment production under winter conditions:

1. Crop residue use.
2. Cover and green manure crops.
3. Conservation cropping for soil conservation and erosion control on all lands.
4. Contour planting.
5. Terraces
6. Planned access roads.
7. Stabilized waterways on the steeper slopes.



The second priority should be given to BMPs which are site specific and include:

1. Channel stabilization measures
2. Streambank protection
3. Diversions
4. Grassed waterways
5. Improved irrigation water management
6. Range management

In addition, Appendix E provides a listing of resource management subsystems/BMPs and the component conservation practices specific for each of the agricultural land uses in the Watershed. Preparers of RCPs shall include all appropriate measures shown on this listing.

(6) A schedule for implementation of the recommended BMPs.

- c. The County of Orange and the City of Irvine monitor the progress of RCP preparation and BMP implementation, and submit progress reports to the Santa Ana Regional Water Quality Control Board (SARWQCB). The progress reports should list plans that have been prepared during the period, and the agricultural land user's self-established time schedule for BMP implementation (but not later than the dates set in the ordinance).

The reports should also include:

- o the percentages of each erosion hazard area for which RCPs have been prepared.
- o the adequacy of the RCPs.
- o an update of the extent of implementation of BMPs for each RCP that has been prepared
- o a technical evaluation of the effectiveness of the RCPs applied.
- o a determination of additional BMPs required.

The completed RCPs will be subject to approval by the City/County.

- d. The California State Water Resources Control Board (CSWRCB) withdraw its designation of the County/City as management agencies if, in its opinion, the County/City is not successful

in implementing an effective agricultural sedimentation control strategy.

- e. If the CSWRCB withdraws its designation of the County/City, the Santa Ana Regional Water Quality Control Board (SARWQCB) will, based on its existing authorities under the Porter-Cologne Act, establish limitations on the amount of sediment discharged from specific water conveyance structures to the waters of the State. It will require that the landowners obtain National Pollution Discharge Elimination System (NPDES) Permits which will implement this 208 Plan and require installation of specific BMPs included herein and monitoring of the results. The SARWQCB should issue clean-up orders for violations, hold a regulatory Board hearing and refer cases of noncompliance to the Attorney General for enforcement and collections of monetary damages.

## B. Improve Construction Land Management Practices

The 208 Areawide Waste Treatment Management Plan amendment relating to construction activities recommends that local governments encourage utilization of the best management practices (BMPs) recommended in the report "Newport Bay Watershed: Construction Activities Best Management Practices Plan for Sedimentation Control". The amendment includes recommendations regarding requirements for sediment control plans, training programs, working relationships with developers and contractors and that the Santa Ana Regional Water Quality Control Board (SARWQCB) maintain an active supervisory role in the program.

When urban development occurs, there is a limited period during the construction phase when the land is highly susceptible to erosion. On average, these construction sites are the highest producers of sediment, averaging 9,200 tons/sq. mile in the foothill areas, and 6,000 tons/sq. mile in the valley areas. In aggregate, construction sites produce about 15 percent of the total sediment in the watershed, or about 19,500 tons on an average annual basis. High erosion rates on construction sites occur during a limited period because of the practices of the local jurisdictions, through either their grading or zoning codes, which require developers to stabilize all constructed slopes and open space with landscaping. During the construction phase land management practices will decrease sediment production from these areas, resulting in reduced costs of sediment removal from downstream channels, sedimentation basins, and Newport Bay. Downstream structural measures will still be needed to manage the sediment produced but maintenance costs and most environmental impacts to Bay will be reduced as the effectiveness of land management practices is improved.

### 1. Construction Activities Best Management Plan

The City of Irvine in 1981 completed a report on the Newport Bay Watershed entitled "Construction Activities Best Management Practices Plan for Sediment Control" that investigated the reduction of sediment produced at construction sites by the application of Best Management Practices (BMPs). These BMPs consist of

structural measures used at sites described in the Report, and non-structural measures involving administrative and regulatory processes.

Based on a review of applicable BMPs and their present use, the following practices are recommended for occasional-to-frequent use:

1. Temporary gravel construction entrance
2. Sandbag, gravel bag or straw bale barriers
3. Silt fences
4. Filter berms
5. Filter inlets
6. Interceptor ditches
7. Diversion dikes
8. Active fill diversions
9. Permanent diversions
10. Perimeter berms or swales
11. Right-of-way diversions
12. Stormwater channels
13. Slope drains
14. Outlet protection
15. Level spreader
16. Riprap
17. Streambank stabilization
18. Grade control structures
19. Vegetation protection
20. Vegetation establishment
21. Mulches
22. Temporary sediment traps
23. Temporary sediment basins
24. Permanent debris basins
25. Topsoiling
26. Dust control
27. Stockpile stabilization

Four of the practices are now used only rarely in the watershed: silt fences, level spreaders, vegetation protection, and topsoiling. The Soil Conservation Service also recommends that the use of vegetation protection and topsoiling be encouraged.

## 2. Current Requirements for Construction Site BMPs

The three major jurisdictions in the Watershed: the cities of Irvine and Newport Beach and Orange County; and the City of Costa Mesa, maintain relatively uniform ordinances, standards, and procedures requiring erosion control measures in connection with grading activities. Erosion control plans are required by these jurisdictions for any grading occurring between October 15th and April 15th. Fees to defray the costs of plan checks and inspections are paid by the developers. Stop work orders are issued for violations of approved plans.

Orange County's guidelines for erosion control plans include the objective of minimizing the amount of sediment transported from projects under active grading permits to sensitive receiving waters.

The three major jurisdictions in the Watershed have grading manuals and/or standards which accompany their grading ordinances. These manuals are approved and adopted by the relevant government body (Board of Supervisors, City Council) through a resolution. For example, the Orange County Grading and Excavation Code Section 7-1-801, Grading Manual, authorizes the Director of the Environmental Management Agency to formulate rules, procedures, and interpretations necessary to carry out the provisions of the grading ordinances or codes. The grading manuals can be amended only through resolution. A building official (or City Engineer) has the authority to require of the developer specifics regarding grading permits, etc., as stated in the manual.

The City of Orange is applying an extensive set of standards in its approach to erosion/sedimentation control. The success or failure of this approach will have little effect on Newport Bay because the drainage area within the City is small compared to the total Watershed.

The City of Tustin, which has a relatively large undeveloped foothill area, does not have sedimentation control regulations.

The Irvine Company develops annual specific programs for control of erosion on construction sites within the Company's jurisdiction. The purpose as stated in the 82-83 Program is, "... to comply with the City/County ordinances, State law, and to fulfill the Company commitment to control erosion and transportation of sediment from our construction projects."

The Santa Ana Regional Water Quality Control Board reviews, approves, and monitors erosion control plans for projects under the jurisdiction of the County of Orange and the cities of Irvine and Newport Beach.

### 3. 208 Areawide Waste Treatment Plan Amendment

The 208 Areawide Waste Treatment Plan Amendments prepared by the Southern California Association of Governments, dated September 1982, include summaries of findings and recommended actions to control sediment production by construction activities. A copy of this Amendment is included in the Appendix.

### 4. Recommendations

- a. Cities in the Watershed adopt water quality protection as a goal of their grading ordinances.
- b. The City of Tustin institute an erosion/sediment control program at the earliest possible time.



- c. The City of Irvine and Orange County enforce their grading ordinances through the collection of debris deposits or other types of bonds that are effective.
- d. Jurisdictions include sediment reduction as an objective in siting and building design approvals for developments in hillside areas. The Hillside Slope Development Manual prepared by the City of Irvine is an example of a way to achieve this objective.

In addition to BMPs applicable to all construction areas, specific considerations for the control of erosion on hillside areas include:

- (1) Fitting the development to the particular topography.
  - (2) Exposing the smallest practical area of land for the shortest possible time.
  - (3) Minimizing earth movement and establishing protective vegetative cover after final grading.
  - (4) Locating buildings and driveways to minimize land disturbance, leaving steep slopes undisturbed.
  - (5) Including design features that would minimize grading requirements.
  - (6) Locating, designing and stabilizing drainage channels to prevent erosion.
- e. Jurisdictions in the Watershed include a provision in their grading ordinances that would require landowners to correct existing significant erosion caused by construction activities.
  - f. Jurisdictions prohibit major land clearing except immediately prior to grading and construction.
  - g. Jurisdictions issuing permits for erosion control plans implement the following:
    - (1) Require that review, approval and inspection of erosion control plans be by personnel trained in the application of erosion control measures.
    - (2) Actively promote and participate in erosion control training programs for their Staff, such as those sponsored by SCS and workshops conducted by organizations such as the Association of Bay Area Governments and SCAG.
- The Santa Cruz County RCD has developed successful training programs and guidelines for use by other jurisdictions.
- (3) Improve communication between plan checkers and site inspectors.
  - (4) Require all plans to be site specific.

- (5) Require more detailed analyses for sites with steep slopes and/or highly erodible soils.
  - (6) During the rainy season prohibit major grading on high erosion hazard sites as identified on the SCS "Erosion Hazard Map" which, due to steep slopes and/or easily erodible soils, are potentially high producers of silts and clays unless it can be demonstrated that the approved erosion control plan will be effective in preventing transportation of substantial quantities of silts and clays from the site.
- f. The Santa Ana Regional Water Quality Control Board maintain an active supervisory role by performing periodic site inspections and by requiring annual reports from local jurisdictions when water quality goals are not being met.

#### C. Install In-Channel Basins

- 1. With land management practices applied to agricultural lands and construction sites at the present rate of intensity and effectiveness, and with the "Early Action Plan" functioning, approximately 60,500 tons of sediment on an average annual basis will be delivered to Newport Bay from the Watershed. With the application of additional land management practices as recommended, the amount of sediment delivered to Upper Newport Bay would be reduced. Ultimately, when the agricultural lands are developed and construction activities are relatively insignificant in the Watershed, 35,000 tons of sediment on an average annual basis will continue to be delivered to Newport Bay.
- 2. The installation of the two in-channel basins in San Diego Creek as part of the "Early Action Plan" has been demonstrated to be an effective partial solution to the problem of sediment inflow to Newport Bay. During the 1982/83 rainy season these basins, with a combined capacity of 282,000 cubic yards (175 acre-feet) below the invert elevation of the San Diego Creek flood control channel, trapped large amounts of sediment that would otherwise have discharged into Newport Bay. However, it was also demonstrated during this season of high runoff that additional basin capacity is required to assure effective trap efficiencies during major storms.
  - a. The estimated costs of removal of sediment from in-channel basins is \$3 per ton vs. \$7.50 from the Bay.
  - b. Sediment deposition in in-channel basins will result in less frequent disturbance of the Ecological Reserve for sediment removal.
  - c. In Task III-D, Development and Comparison of Alternative Management Systems, it was shown that additional in-channel basins would be the most cost effective structural measures

for downstream control of all sand particles and a portion of the silt particles.

### 3. Recommendations

Install three additional in-channel basins in San Diego Creek channel between the upstream "Early Action Plan" basin and the junction with Peters Canyon Wash (Figure 9) with a combined capacity of 273,000 tons (169 acre-feet). The total in-channel basin capacity, when combined with the "Early Action Plan", will be 555,000 tons (344 acre-feet).

### 4. Effectiveness

- a. The three additional in-channel basins when combined with the two existing in-channel basins will intercept on an average annual basis 32,800 tons of sediment, thus reducing the average annual inflow into Newport Bay to 52,700 tons.
- b. In the future, as sediment is reduced by the recommended improved land management practices on agricultural lands and construction sites, urbanization of agricultural lands, stabilization of channels, and construction of some foothill basins, less sediment will be deposited in these in-channel basins and in Newport Bay, resulting in reduced maintenance costs.

### D. Install In-Bay Basins

1. With land management practices applied to agricultural lands and construction sites at the present rate of intensity and effectiveness and the three in-channel basins constructed, approximately 52,700 tons of sediment on an average annual basis, will continue to be delivered to Newport Bay. With the application of additional land management practices, as recommended, the amount of sediment delivered to Upper Newport Bay will be reduced. This sediment will consist of fine silt and clay particles that are not conducive to entrapment in in-channel basins because of the relatively short detention time.
  - a. In Task II-E, Sediment Transport, Deposition, and Scour in Upper Newport Bay, Ray B. Krone & Associates reported that when stream flows mix with ocean waters to the extent of one or two parts or more ocean water to 32 parts stream water, the clay particles become cohesive. In this same Report, it is concluded that 80 percent of the clay and fine silt particles entering the Bay are retained in the natural basin between The Narrows and the old salt works dike. It was further concluded that this natural basin will continue to fill with sediment, and its effectiveness in trapping fine sediment will diminish, resulting in deposition of sediment lower in the Bay.

- b. As part of the "Early Action Plan" an excavated basin was constructed in Upper Newport Bay immediately downstream of Jamboree Road. The basin has a surface area of 50 acres, a bottom elevation of -3.0 feet mean sea level (MSL) and side slopes of 10:1. The amount of sediment storage capacity below 0 MSL is about 142,000 tons (88 acre-feet). If sediment is allowed to accumulate above this elevation, tidal movements into the area will be inhibited thus reducing coagulation and deposition of clay particles. It has been estimated that all of the sand particles and 20 percent of the silt and clay particles entering Upper Newport Bay will be trapped by this basin. With the recommended additional in-channel basins installed, approximately 14,000 tons of sediment will be deposited in this basin on an average annual basis.

## 2. Recommendations

- a. Construct additional basins in Upper Newport Bay with a surface area of approximately 54 acres. The basins should have a depth of -4 feet MSL and 10:1 side slopes.
- b. The additional basin or basins should be located adjacent to the "Early Action Plan" basin, or in the "natural basin" area between The Narrows and the old salt works dike.
- c. The exact location and configuration of the basin or basins should be compatible with the State Department of Fish and Game Management Plan for the Ecological Reserve.

## 3. Effectiveness

The combined sediment storage capacity in the Bay basins below 0 MSL would be 445,000 tons (276 acre-feet). With the installation of the recommended in-channel and Bay basins it is estimated that 94 percent of the existing average annual sediment inflow of 85,500 tons to Upper Newport Bay will be trapped, thus localizing the deposition and facilitating its management.

## E. Channel Stabilization

1. Using the methodology explained in Section III of this report, under existing conditions the estimated average annual channel erosion is 38,800 tons, and under ultimate conditions of development without channel stabilization measures, it is estimated to be 90,700 tons. A large percentage of this eroded material is composed of sand particles that will deposit in downstream channel reaches or in the recommended in-channel sedimentation basins. This study has indicated that under existing conditions, with all channels stabilized, the average annual sediment inflow to Upper Newport Bay would be reduced 6,100 tons. Under ultimate conditions, the average annual sediment inflow to Upper Newport Bay would be reduced 17,400 tons with all channels stabilized.



- a. Sediment produced from channel erosion increases the amount of sediment discharged into the Bay, decreases channel capacities and increases costs of deposition removal from downstream channels and the recommended in-channel sedimentation basins.
- b. Channels in undeveloped areas are difficult to stabilize because the ultimate location and type of drainage facility is a function of the future abutting development. Neither private property owners or public agencies are willing to finance stabilization measures for channels that are not permanent.
- c. There are some existing channels in dedicated rights-of-way that are in permanent locations that are not fully stabilized. Examples of this condition are San Diego Creek from Upper Newport Bay to Culver Drive and Peters Canyon Wash from the confluence with San Diego Creek to the Santa Ana Freeway. The beds of these channels are not eroding, but the sideslopes are not lined or vegetated and thus are subject to erosion.

## 2. Recommendations

- a. Public jurisdictions require as conditions of approval for dedication that all channels be stabilized to minimize sediment production within and adjacent to a proposed development.
- b. Public jurisdictions inspect existing dedicated channels and inventory unstabilized conditions.
- c. Public jurisdictions prepare a list of dedicated channels requiring improvements and establish priorities. Measures considered should include concrete lining, guniting, rock surfacing or vegetating of side slopes and stabilization of flow lines by drop structures. Consideration should also be given to correcting localized erosion at bridge structures, drop structures and channel inlets.

## F. Foothill Basins

- 1. The installation of the foothill basins would reduce peak stormflows. Consequently, erosion of unstabilized channels would be reduced, sediment transported through the drainage system would be decreased and the effectiveness of the downstream in-channel basins would be improved. However, sand particles trapped by the foothill basins would tend to be replaced by sand particles eroded from downstream unstabilized channel sections. A major economic benefit that would be obtained from the installation of the foothill basins is the reduction in costs for downstream channel improvements.
  - a. The basins will have both flood control and sediment control benefits.

- b. It is not probable that many of these basins will be installed near term because their economic justification will be related to downstream urban development.
- c. The County of Orange and The Irvine Company are developing a master drainage plan for the Watershed.

## 2. Recommendations

- a. The drainage master plan for the Watershed should include sediment control by installation of foothill basins.
- b. Foothill basins constructed for flood control purposes should include capacity for sediment control.

## G. Monitoring

- 1. A comprehensive sediment monitoring program within the Watershed and Newport Bay is essential to verify the results of this study, determine the effectiveness of installation of the recommended structural measures, and indicate the effect of changing land uses on sediment production.

Monitoring of sediment transport in channels in the Watershed can be based on established procedures developed by the U. S. Geological Survey. In 1982 the U. S. Geological Survey contracted with the City of Newport Beach, the City of Irvine, and The Irvine Company for a sediment monitoring program in the channels upstream of Upper Newport Bay. Monitoring of sediment transport, deposition and scour in Newport Bay will be complex and costly.

Since sediment production is a function of storm return periods, a time span of 10 years or more may be required to obtain useful data.

## 2. Recommendations

- a. Continue the monitoring program established with the U. S. Geological Survey. This program should include operation of continual stream gage and daily suspended-sediment stations at representative locations, collection of samples of sediment deposits from installed sedimentation basins, and maintenance of records on volumes of material removed from sedimentation basins.
- b. Department of Fish and Game establish a monitoring program for Upper Newport Bay. The first priority should include regular hydrographic surveys, topographic maps and measurements of cross-sections of the channels at intervals of 5 to 10 years. If it is found that the management plan proposed by the Department requires prediction of suspended solids concentration or rates of deposition or erosion, it would be necessary

to construct a model. A description of the data required for the model is included in Task II-E.

## VI. PROJECT COSTS, IMPLEMENTATION AND FUNDING

### A. Estimated Costs

The estimated capital and maintenance costs are shown on Table 13.

#### 1. Cost Considerations

- a. Due to the inherent limitations, estimated capital and maintenance costs cannot be determined for the land management elements of the recommended plan. This is because the extent and therefore the costs of the BMPs that will be applied will be site specific. The extensive analysis required to obtain any useful cost information was not within the scope of this study.
- b. Costs for the recommended sedimentation basins in the San Diego Creek channel have been extrapolated from the actual contract costs for the "Early Action Plan" and from recent costs Orange County has experienced in contracts for removal of sediment from channels. These costs will vary widely depending on whether or not there is a market for the deposited sediment.
- c. The costs for excavation and maintenance of the in-Bay basins will be dependent on the locations of the basins, the methods of removal and the availability of disposal sites.
- d. Channel stabilization costs have not been estimated. However, they will be substantial. In the undeveloped areas, most of the stabilization costs are expected to be borne by developers. The costs of stabilizing existing dedicated channels will be dependent on the extent and type of measures required.
- e. The costs to install the foothill basins were estimated on the basis of estimates that were made for previous studies of the basins. The capital costs exclude land rights and relocation of utilities. The capital costs attributable to flood control and those to sediment management have not been assigned.
- f. The upstream monitoring program cost estimate is based on the current U. S. G. S. contract. The estimated cost of the recommended Bay monitoring has not been determined.

#### 2. Other Costs

Additional costs of the Plan not estimated on Tables 13 will be borne primarily by landowners, developers and the Orange County Flood Control District.

- a. Agricultural land management practices.
- b. Construction land management practices



TABLE 13

## ESTIMATED PROJECT COSTS

AVERAGE MANUAL  
MAINTENANCE COSTS

PLAN ELEMENTS	CAPITAL COST	AVERAGE MANUAL MAINTENANCE COSTS	
		EXISTING CONDITIONS	ULTIMATE CONDITIONS (1)
A. Improve Agricultural Land Management Practices	Not Estimated	Not Estimated	None (2)
B. Improve Construction Land Management Practices	Not Estimated	Not Estimated	None (2)
C. In-Channel Sedimentation Basins	\$ 2,000,000 (3)	(4)	(4)
Remove additional deposition caused by basins	---	\$ 59,700	\$ 18,600
Remove normal deposition in channel reaches	---	\$214,800	\$ 3,300
D. In-Bay Basins (additional basins)	\$ 3,525,000	(4)	(4)
Remove sediment deposited in Bay (including excavated basins)	---	\$359,250	\$207,000
E. Stabilize Channels	Not Estimated	Not Estimated	Not Estimated
F. Foothill Basins	\$10,878,200 (5)	(4)	(4)
Remove sediment deposited in basins	---	\$ 99,000	\$ 82,800
G. Monitoring			
Upstream	Included in Maintenance Cost	\$ 84,000	\$ 84,000
In-Bay	Not Estimated	Not Estimated	Not Estimated
TOTAL OF COSTS ESTIMATED	\$16,403,200	\$816,750	\$395,700

(1) Assumes all channels stabilized.

(2) No Cost - assumes all channels stabilized and watershed fully developed.

(3) For the recommended three additional in-channel basins.

(4) Structural maintenance costs not estimated.

(5) Excluding costs for land rights and relocation of utilities.

## Notes:

1. Costs include allowance for engineering, administration and contingencies.

2. ENR cost index March 1982 = 3729.

- c. Channel stabilization in undeveloped areas.
- d. Stabilization of channels in dedicated rights-of-way
- e. Foothill basins

## B. Schedule for Implementation

All elements of the Plan should be implemented as soon as possible in order to achieve a maximum reduction of sediment inflow to Upper Newport Bay and to facilitate the management of the sediment that is depositing in the Bay.

### 1. Improved Agricultural Land Management Practices

A varying number of BMPs are in place throughout the Watershed. In order to improve the land management practices, the recommended RCPs need to be completed and implemented as follows:

- o High erosion areas
 

Complete RCPs by Nov. 1983
Implement BMPs by Nov. 1984
- o Remaining areas
 

Complete RCPs by Nov. 1984
Implement BMPs by Nov. 1985

### 2. Improved Construction Land Management Practices

The cities of Irvine and Newport Beach, and Orange County are the major jurisdictions in the Watershed and are currently requiring erosion control measures for all construction sites. The recommended actions should be implemented as follows:

- o City of Tustin-institute
 

an erosion/sediment control program.	By Sept. 1984
--------------------------------------	---------------
- o Grading ordinance changes
 

<ul style="list-style-type: none"> <li>a) Water quality protection</li> <li>b) Debris deposits or bonds</li> <li>c) Correction of existing erosion</li> <li>d) Prohibition of major land clearing in advance of grading and construction</li> <li>e) prohibition of grading on high erosion hazard sites during rainy season</li> </ul>	By Sept. 1984
---	---------------
- o Erosion control training
 

programs	Begin Jan. 1, 1984
----------	--------------------
- o Other administrative
 

procedures	By September 1984
------------	-------------------

### 3. Install Three Additional In-Channel Basins

The "Early Action Plan" basins are completed and functioning. However, the recommended additional basins will provide improved effective trap efficiencies during major storms. Construction of these basins can be accomplished in phases, but will require implementing and funding agreements as described in Section VI of this Report:

- o Cooperative Agreement                      Oct. 1, 1983
- o Implementing Agreement                      July 1, 1984
- o Construction of Basins                      Begin May 1, 1985  
Complete all basins  
by 1988

### 4. Install In-Bay Basins

The primary purpose of the In-Bay Basins is to localize the deposition of sediment and to facilitate its management. The basin constructed below Jamboree Road, as part of the "Early Action Plan", will trap approximately 20 percent of the silt and clay particles flowing into the Bay. Construction of the recommended basins can be accomplished in phases, but will require implementing and funding agreements and coordination with the Department of Fish and Game Management Plan.

- o Adoption of Management Plan              Jan. 1, 1984
- o Cooperative Agreement                      Oct. 1, 1983
- o Implementing Agreement                      July 1, 1984
- o Construction of Basins                      Begin May 1, 1985  
Complete by 1990

### 5. Channel Stabilization

It should be recommended that stabilization of channels in undeveloped areas be required as a condition of development approval. Stabilization of existing channels in dedicated rights-of-way should be recommended to be accomplished by the public jurisdictions and therefore would require special funding.

- o Undeveloped areas - January 1, 1984  
     Jurisdictions require  
     stabilization of channels  
     as a condition of dedication
- o Dedicated channels  
     Prepare inventory of July 1, 1984  
     required improvements
- Installation of Begin July 1, 1984  
     Stabilization measures Complete 1988

#### 6. Foothill Basins

The major economic justification for the construction of foothill basins will be the reduced costs for downstream channel improvements. The installation of the basins will not result in significant reductions of sediment production until downstream channels are stabilized.

- o Incorporation into As part of plan  
     drainage master plan development
- o Construction Concurrent with  
     stabilization of  
     downstream channels

#### 7. Monitoring

A monitoring program for the channels, conducted by the U. S. Geological Survey, was started in 1982. The local funding is shared by the cities of Irvine and Newport Beach, and The Irvine Company. Under "Project Funding" it is recommended that this monitoring as well as a Bay monitoring program be included in a cooperative agreement.

- o Cooperative Agreement Oct. 1, 1983
- o Bay Monitoring  
     Develop program Jan. 1, 1984  
     Implement program July 1, 1984

### C. Project Funding

Implementation of the recommended Plan will require funding for the installation of the proposed measures and for their continued maintenance. The institutional, financial and legal procedures for effective implementation of the Plan must be established

To provide equitable financing of the capital investment and maintenance costs requires recognition of both the sources of sediment being deposited in Upper Newport Bay, and the benefits that will



accrue to public and private interests by preventing further degradation of and/or restoring desirable conditions in the Bay.

The average annual amounts of sediment produced by land uses under existing conditions of land use and management in the Watershed are summarized as follows:

<u>Land Use</u>	<u>Sediment Produced</u>	
	<u>1000 Tons</u>	<u>Percent of total</u>
Open Space	56.5	42.0
Agricultural	54.6	41.0
Urban	3.3	2.0
Construction	19.5	15.0
	-----	-----
	133.9	100.0

Types of benefits that will accrue from the implementation of the recommended Plan and some of the beneficiaries are:

<u>Types of Benefits</u>	<u>Beneficiaries</u>
1. Protection and enhancement of the Bay as a wildlife habitat	State Dept. of Fish Game, U.S. Fish and Wildlife Service
2. Maintenance of design capacities of flood control channels	Orange County Flood Control District
3. Improved aesthetic values of Bay	Adjacent property owners in City of Newport Beach, motorists and visitors
4. Protection of recreational and commercial uses of Upper and Lower Newport Bay	Boat and slip owners, Orange County Harbor District, City of Newport Beach, U.S. Corps of Engineers

#### 1. Potential Implementors

The implementation of the recommended Plan will need to be accomplished by one or more of the public agencies with jurisdiction in the Watershed with the cooperation and participation of the Irvine Company, the major landowner. The public agencies with jurisdiction in the basin are:

City of Newport Beach  
City of Irvine  
City of Costa Mesa  
City of Santa Ana  
City of Tustin  
County of Orange  
Orange County Harbor District  
U.S. Corps of Engineers  
State Department of Fish and Game  
Santa Ana Regional Water Quality Control Board  
U.S. Fish and Wildlife Service

- a. The portions of the cities of Costa Mesa, Santa Ana and Tustin within the Watershed are mostly developed, and consequently, are not significant sediment sources. The Orange County Harbor District, the U.S. Corps of Engineers, the Santa Ana Regional Water Quality Control Board, and the U.S. Fish and Wildlife Service, although having interests in the basin, are not staffed or constituted to implement either the construction or maintenance aspects of the proposed plan.
- b. The cities of Newport Beach and Irvine, the County of Orange, and the State Department of Fish and Game are the agencies that can most logically implement the various elements of the Plan.
- c. The State Department of Fish and Game is the owner of the ecological reserve where the in-Bay element of the Plan will be installed.
- d. The Orange County Flood Control District is the owner of the San Diego Creek channel where the in-channel sedimentation element of the Plan will be constructed, and where most of the channel deposition occurs. The District removes sediment deposits from this channel as well as from other major channels in the County.
- e. A joint powers agency could not include The Irvine Company since they are not a public agency.

The State legislature would need to adopt legislation in order for the State Department of Fish and Game to be a member of a joint powers agency.

Cooperative agreements could include local and State public agencies as well as private land owners like The Irvine Company.

- f. Construction and maintenance costs of the Plan should be assigned based on considerations of the sources of the sediment, the benefits to be received by controlling the sediment deposits in the Bay and the flood control channels, and channel maintenance practices for other watersheds within the County.

- g. An equitable share of the Plan costs to be borne by public agencies would be the portion represented by sediment produced from "natural conditions". Except for the foothills, most of the Watershed has been disturbed by man. Since man has constructed channels and converted large portions of the Watershed to agricultural and urban uses it is difficult, if not impossible, to determine the amount of sediment that would have reached the Bay before the man-made changes. However, as described in Task II-B, Geomorphic Analysis, it was the construction of man-made ditches and the improvement of natural channels that provided an efficient means of transporting sediment produced in the foothills to Upper Newport Bay. Forty-two percent of the sediment produced is from open space, which has not been significantly changed by man. Therefore, a reasonable allocation would be to assign costs for management of sediment produced from open space to the public agencies, and the costs for management of sediment produced by agricultural lands and construction sites to the landowners.
- h. In addition to funding the capital and maintenance aspects of the Plan, it is important that the various entities in the Watershed bind themselves together for the purposes of implementing all aspects of the Plan, evaluating and assessing the effectiveness of the various elements of the Plan, and to create a forum for public discussion.

## 2. Recommendations

- a. Enter into cooperative agreements to implement and fund the Plan. The parties to, purposes and elements of these agreements should be as follows:
  - (1) Umbrella Cooperative Agreement
    - (a) Parties to Agreement:
      - o County of Orange
      - o City of Irvine
      - o City of Newport Beach
      - o State Department of Fish and Game
      - o The Irvine Company
    - (b) Purposes:
      - o Adopt and implement the Plan
      - o Evaluate and assess the effectiveness of the various elements of the Plan
      - o Assure uniformity of erosion control ordinances and applications of agricultural and construction land management practices.
      - o Create a public forum for discussion of Watershed sedimentation problems.

- o Maintain and fund sediment monitoring programs for the Watershed and the Bay.

(c) Policy committee:

The agreement should establish a policy committee that would meet at least twice yearly, and would be responsible for determining whether adequate and reasonable progress is being made in the implementation of the Plan.

(2) Implementing Agreements

- (a) The purpose of the implementing and funding agreements would be to fund the construction and maintenance of the recommended three in-channel sedimentation basins and the in-bay basin or basins. This purpose could be accomplished with either one or two agreements.

(b) Parties to agreements:

- o County of Orange
- o City of Irvine
- o City of Newport Beach
- o State Department of Fish and Game
- o The Irvine Company

(c) Lead agencies:

- o In-channel basins - County of Orange
- o In-Bay basins - State Dept. of Fish and Game

- (d) Removal of sediment from channels and from in-channel basins should be the responsibility of Orange County Flood Control District.

(e) Technical Advisory Committee:

The agreements should provide for a technical advisory committee to make recommendations on technical aspects of implementing the Plan.

(f) Cost Sharing

Based on the sources of the sediment produced, the various benefits derived, the ownership of the ecological reserve, and the present policies for



sediment removal, the capital and maintenance costs for the in-channel and in-Bay elements of the Plan should be assigned as follows:

In-Bay Basins - Capital and Maintenance Costs

<u>Entity</u>	<u>Source of Sediment</u>	<u>Percent of Costs</u>
1. Department of Fish and Game, City of Newport Beach, and Orange County Harbor District	Open Space	42
2. Cities of Newport Beach and Irvine, and County of Orange	Urban Areas	2.5
3. Landowners	Construction Sites	14.5
4. Landowners	Agricultural Sites	41
		-----
Total		100

In-Channel Basins - Capital Cost

<u>Entity</u>	<u>Source of Sediment</u>	<u>Percent of Costs</u>
1. Cities of Newport Beach, Irvine, and County of Orange	Open Space and Urban Areas	44.5
2. Landowners	Construction Sites	14.5
3. Landowners	Agricultural Lands	41
		-----
Total		100

Sediment Removal from Channels and from In-Channel Basins

<u>Entity</u>	<u>Percent of Cost</u>
1. Orange County	100

- b. Efforts should be made by the parties to secure State and/or Federal grants as they become available. The grants can be justified as a means of paying for some of the overriding public benefits which have been enumerated but not assigned a cost share in the formula. Funds received from these sources could be used to reduce the local contributions recommended.
- c. Funding of the other elements of the Plan should be as follows:

<u>Element</u>	<u>Funding</u>
(1) Improve agricultural land management practices	Landowner
(2) Improve construction land management practices	Landowner
(3) Channel stabilization:	
(a) Undeveloped channels	Developer
(b) Dedicated channels	Public agencies having jurisdiction
(4) Foothill basins	
(a) Capital Cost	Downstream beneficiary of cost savings resulting from reduced channel sizes
(b) Sediment removal	Public agencies responsible for removal of sediment from downstream facilities

## VII. ENVIRONMENTAL IMPACTS

A separate environmental impact document has been prepared entitled "Environmental Impact Report, Newport Bay Watershed: San Diego Creek Comprehensive Stormwater Sedimentation Control Plan".

### A. Land Management Practices

The more intensive application of best management practices (BMPs) on agricultural areas and construction sites will reduce sediment production from these areas. The amount of decrease that will be obtained has not been quantified because of limited information regarding their effectiveness and the potential extent of application. The application of these BMPs will have positive environmental impacts by reducing siltation and water quality impacts on streams and Upper Newport Bay.

The reduced amounts of sediment deposited in stream channels will decrease the negative environmental impacts caused by sediment removal from the channels and in-channel basins. The decreased amounts of sediment inflow to Upper Newport Bay will also reduce the negative environmental impacts caused by sediment removal operations and will reduce the negative impacts of sedimentation on the management of the Upper Newport Bay Ecological Reserve.

### B. Structural Measures

All of the structural measures, separately and in combinations, will have positive environmental impacts in the watershed by reducing the amounts of sediment transported into Upper Newport Bay. These measures will also have adverse environmental impacts, generally limited to the construction phases and maintenance periods.

Channel stabilization measures will decrease the production of sediment by channel erosion and consequently reduce the sediment inflow to Upper Newport Bay and channel maintenance costs. Moderate adverse impacts are primarily construction related. Long-term impacts will result from loss of open space and wildlife habitats.

Structural measures included in the Early Action and Interim Plan (EA & IP) will cause a reduction in the sediment inflow to Upper Newport Bay and better management of sediment that enters the Bay. The primary benefits will be reduced sedimentation in Upper Newport Bay, improved water quality and enhancement of significant wildlife habitats. Moderate adverse impacts are construction related.

Installation of the three additional in-channel basins will cause additional reductions in the sediment inflow to Upper Newport Bay and will provide more effective trapping of sediment transported by major stormflows than would the EA & IP alone. The benefits

would be similar but greater than those obtained with the EA &IP alone. Moderate adverse impacts will be construction related.

Installation of the 12 foothill basins will provide floodwater retarding and control of sediment produced by their drainage areas. These effects will reduce the amounts of sediment transported by the downstream channel system and the inflow of sediment to Upper Newport Bay. This will provide benefits to the water quality and biological resources in Upper Newport Bay. The adverse overall short-term impact would be major due to construction occurring throughout the foothills. Similar moderate impacts would be caused by maintenance operations. The major adverse long-term impact would be the loss of open space.



## **APPENDICES**



## APPENDICES

- Appendix A - SCAG 208 Areawide Waste Treatment Management Plan  
September 1982 (including changes included in addendum  
dated January 1983)  
Newport Bay Watershed - Construction Activities  
Newport Bay Watershed - Agricultural Activities
- Appendix B - Resolution No. 83-534 of the Board of Supervisors of  
Orange County, California dated April 12, 1983, to implement  
the recommendations in the SCAG 208 Amendment pertaining to  
preparation and implementation of Resource Conservation Plans  
(RCPs) and annual reporting and inspection.
- Appendix C - Resolution No. 81-113 of the City Council of the City of  
Irvine approving in concept the implementation and enforcement  
of those elements of the South Coast Areawide Waste Treatment  
Management Plan appropriate to the City of Irvine.
- Appendix D - Resolution No. 11083 of the City Council of the City of  
Newport Beach supporting the implementation of an  
agricultural activities sedimentation control plan for  
Upper Newport Bay Watershed.
- Appendix E - Best Management Practices (BMPs) recommended by the SCS,  
specific for each of the agricultural land uses in the  
Newport Bay Watershed.





NEWPORT BAY WATERSHED-CONSTRUCTION ACTIVITIES

INTRODUCTION

Construction activities in the Newport Bay Watershed have contributed to the adverse sedimentation problem in Upper Newport Bay. A report was prepared in cooperation with the City of Irvine entitled, "Newport Bay Watershed: Construction Activities Best Management Practices Plan for Sedimentation Control," which recommends a sedimentation control plan for construction activities in the Upper Newport Bay Watershed employing best management practices (BMPs). The plan defines and recommends specific practices to be used on construction sites in the watershed, suggests changes in existing grading ordinances and administrative procedures and describes the framework for regulating the erosion and sedimentation aspects of construction activities. These recommendations would eventually tie in with the Comprehensive Sedimentation Control Plan for Upper Newport Bay.

FINDINGS

1. None of the jurisdictions in the Watershed specify water quality protection as a goal in their grading ordinances. Irvine, Newport Beach, and Orange County ordinances are based on the model grading ordinances in the Uniform Building Code (UBC) with an emphasis on erosion and sediment control. However, as written, the UBC ordinance does not apply directly to erosion/sediment control on construction sites, but rather is directed toward reduction of hazards from cut and fill operations to adjacent property and to the public. Inclusion of water quality protection goals in ordinances through erosion control and sediment reduction would strengthen enforcement procedures in nonhazardous situations.
2. At present, the Tustin ordinance does not contain specific requirements for erosion control measures. Historically, such controls were not required because the city occupied flat terrain which was not subject to severe erosion. Recently, however, Tustin has annexed lands which extend into the foothills and which are expected to be developed eventually. At such time when development plans are begun, it will be necessary for the city to review the institution of erosion controls.
3. Grading ordinances specify methods of enforcement for inadequate erosion control measures which include warning by inspectors, stop-work orders, or withholding of building permits. If such measures were ineffective, cities had the alternative of doing remedial work on a site and recovering the cost from the bond which all contractors must post. This alternative is used only in extreme emergencies because of time involved in recovering the bond. This bond is held until final project improvements are made.

The City of Newport Beach utilizes an additional enforcement tool--the debris deposit. This deposit by contractors is forfeited when the inspector finds construction practices that do not conform to the

erosion control plan. Since it can be more easily recovered by the city than a bond, it would provide greater leverage and be more effective as an enforcement measure.

4. The report recommends 27 BMPs as appropriate for occasional-to-frequent use in the Newport Bay Watershed. All but four of the practices are now commonly used in the area. BMPs recommended include such practices as construction site road stabilization, sediment filters and traps, diversion dikes and interceptor ditches, streambank stabilization, topsoiling, and dust control.
5. Specific erosion and sediment control measures can be most effectively applied through appropriate education, training and demonstration sessions to those responsible for their planning, selection and implementation. The Soil Conservation Service provides local erosion control training programs in which agency personnel could participate; or jurisdictions could decide to organize supplementary in-house training for their staffs with emphasis on field applications.
6. An erosion control plan should be required for every project covered by a grading permit if that project extends into the rainy season. No grading permit should be issued unless an erosion control plan has been approved, or the requirement specifically waived by the city. The permit would then be valid for one year, with a new plan to be submitted and approved if grading operations extend into subsequent rainy seasons. Rainy-weather measures should not be filed with the reviewing agency until August or September so that the contractor will have a more precise construction schedule and a more specific erosion control plan.
7. Project schedules should be filed with reviewing agencies so that those expected to extend into the rainy season can be closely monitored. Sites that are graded during the dry season, but left exposed during the rainy season, would thereby be subject to additional rainy season requirements.
8. Voluntary cooperation by developers and contractors is a preferred mode of operation. Good communication between local agencies and developers have been helpful in encouraging compliance and in improving contractors' understanding of city requirements.
9. Responsibility for construction-related erosion control activities lies appropriately with local government. The Regional Water Quality Control Boards cannot specify the methods by which water quality standards are to be met and it therefore falls to cities and counties to regulate land use and promote best management practices that reduce sediment production. This should be continued.

As part of this responsibility, each local jurisdiction should develop effective and efficient procedures for inspection and enforcement of erosion and sedimentation control, if such procedures are not presently in operation. For example, regular meetings held between checkers and inspectors would improve communication and ensure that standards remain consistent. Feedback on field conditions and actual

effectiveness of BMPs would be useful for plan checkers. Also, temporary staff shortages during peak periods could be partially offset by training other inspection personnel, such as building inspectors, in erosion control methods. Besides supplementing regular staff during peak periods, these inspectors would then be able to recognize and report erosion problems on any site while performing their normal duties.

10. While it is the responsibility of local governments to take the lead role in regulating erosion and sediment control, the Regional Board may step in and take necessary enforcement actions to prevent pollution if local governments fail to do so.

The Regional Board can monitor agency performance by requesting periodic reports from management agencies, in accordance with the Porter-Cologne Act. One such report may be requested in October and would list the locations of grading operations, divided between regular grading and engineered grading (greater than 5,000 cubic yards). This list would assist the board in making site inspections during the winter. Another report may be requested by the board in May or June, assessing the agency's enforcement procedures during the preceding rainy season. The following items may be included in the report:

1. types and locations of regulated grading projects, divided between regular and engineering grading;
2. types and design standards of erosion and sediment control measures;
3. number of inspections for each site; and
4. any enforcement actions taken by agency.

The board may wish to forego this detailed report if independent site inspections during the winter indicate that the management agency is rigorously enforcing its grading ordinance.

The board's guidance in the erosion control training program would be helpful in developing a program consistent with water quality goals, and one which encourages uniform enforcement among jurisdictions.

## ACTIONS

### Modifications of Existing Local Grading Ordinances in the Newport Bay Watershed

1. JURISDICTIONS IN THE WATERSHED SHALL ADOPT WATER QUALITY PROTECTION AS A GOAL OF THEIR GRADING ORDINANCES.
2. THE CITY OF TUSTIN SHALL BEGIN REVIEWING ITS GRADING ORDINANCE AND DEVELOP EROSION CONTROL STANDARDS AT THE EARLIEST POSSIBLE TIME, BUT NOT LATER THAN PROPOSED DEVELOPMENT OF FOOTHILL LAND.



3. JURISDICTIONS SHALL ENFORCE THEIR GRADING ORDINANCES THROUGH THE COLLECTION OF DEBRIS DEPOSITS OR OTHER TYPES OF BONDS THAT ARE EFFECTIVE.

Administrative Standards and Procedures for Local Governments in the Newport Bay Watershed

4. LOCAL GOVERNMENTS SHALL ENCOURAGE UTILIZATION OF BEST MANAGEMENT PRACTICES WHICH ARE RECOMMENDED IN THE REPORT, "NEWPORT BAY WATERSHED: CONSTRUCTION ACTIVITIES BEST MANAGEMENT PRACTICES PLAN FOR SEDIMENTATION CONTROL."
5. JURISDICTIONS SHALL ACTIVELY PROMOTE AND PARTICIPATE IN EROSION CONTROL TRAINING PROGRAMS FOR THEIR STAFFS, SUCH AS THE SOIL CONSERVATION SERVICE EROSION CONTROL TRAINING PROGRAM.
6. LOCAL GOVERNMENTS SHALL REQUIRE EROSION AND SEDIMENT CONTROL PLANS FOR ANY PROPOSED CONSTRUCTION PROJECT EXTENDING INTO THE RAINY SEASON (OCTOBER 15 TO APRIL 15).
7. LOCAL GOVERNMENTS SHALL REQUIRE THAT CONSTRUCTION SCHEDULES BE FILED WITH GRADING PERMIT APPLICATIONS.
8. LOCAL GOVERNMENTS SHALL CONTINUE TO MAINTAIN A POSITIVE WORKING RELATIONSHIP WITH DEVELOPERS AND CONTRACTORS TO ENCOURAGE VOLUNTARY COMPLIANCE WITH EROSION CONTROL STANDARDS.
9. LOCAL GOVERNMENTS SHALL CONTINUE TO TAKE THE LEAD RESPONSIBILITY FOR EROSION AND SEDIMENT CONTROL AT CONSTRUCTION SITES.
10. THE SANTA ANA REGIONAL WATER QUALITY CONTROL BOARD SHALL CONSIDER MAINTAINING AN ACTIVE SUPERVISORY ROLE BY PERFORMING PERIODIC SITE INSPECTIONS AND BY REQUESTING ANNUAL REPORTS FROM LOCAL GOVERNMENTS WHEN WATER QUALITY GOALS ARE NOT BEING MET.



NEWPORT BAY WATERSHED-AGRICULTURAL ACTIVITIES

INTRODUCTION

Agricultural and undeveloped lands have been identified as a significant source of sediment to Upper Newport Bay through direct rainfall and drainage across such lands and unstabilized drainage channels. The San Diego Creek Watershed is the largest contributor of sediment to Upper Newport Bay and also contains the largest concentration of agricultural production areas within the Newport Bay Watershed. A comprehensive plan is currently being developed under 208 Phase III continuing planning to control erosion and sedimentation problems in the watershed; however, in order to provide an interim plan for the control of erosion and sedimentation from agricultural activities in the watershed, a study was undertaken in cooperation with the Orange County Environmental Management Agency (OCEMA). The study report, entitled, "Newport Bay Watershed: Agricultural Activities Interim Sedimentation Control Plan," identifies agricultural best management practices (BMPs), or resource management subsystems, for the Newport Bay area and recommends a management plan. The recommended actions in this amendment are based in part on the OCEMA report.

FINDINGS

1. The Newport Bay Watershed has a drainage area of approximately 93,000 acres. Approximately 18,400 acres (20 percent) of the Watershed is in agricultural use, with the principal crops being citrus, avocado, asparagus, miscellaneous row crops, strawberry, ornamental horticulture and rangeland.
2. Generally, it was found that the conveyance structures, including the channels, field drains, and down drains presented more of an erosion problem than the fields and orchards.
3. Conservation practices which have been implemented or are required to control erosion and sedimentation are provided for each of the types of crops found in the watershed and for many of the specific parcels currently in agricultural use. Recommended BMPs include such practices as stream channel stabilization, streambank protection, proper grazing use, road culverts, and mulching.
4. The OCEMA report recommends that the selected conservation practices be implemented in two phases, in line with recommendations offered by the Soil Conservation Service (SCS). The recommended conservation practices for the first phase are those which are minimally necessary for the proper management of the given land use. The second phase recommended practices are alternatives which may be essential or desirable but which must be determined on a site-specific basis.
5. According to SCS representatives, the agricultural land users in the Newport Bay Watershed are generally cooperative in voluntarily implementing recommended conservation practices.

## ACTIONS

1. THE STATE WATER RESOURCES CONTROL BOARD (CSWRCB) SHALL CONSIDER DESIGNATING THE FOLLOWING MANAGEMENT AGENCIES IN THE NEWPORT BAY WATERSHED: ORANGE COUNTY, THE CITIES OF IRVINE AND NEWPORT BEACH. AS SHOWN IN TABLE 10, P. 107, OF THE OCEMA REPORT, THESE GOVERNMENTAL ENTITIES HAVE THE LEGAL, ADMINISTRATIVE, AND FINANCIAL CAPABILITY TO CARRY OUT THE FOLLOWING PROPOSED ACTIONS.
2. EACH ABOVE-SPECIFIED COUNTY/CITY SHALL CONSIDER ADOPTING A LOCAL ORDINANCE DESIGNED TO EFFECT IMPLEMENTATION OF A MANAGMENET CONTROL STRATEGY MITIGATING SEDIMENTATION IN NEWPORT BAY.
3. EACH LOCAL ORDINANCE PREPARED BY THE COUNTY/CITY SHALL REQUIRE A CONSERVATION PLAN TO BE PREPARED BY THE USDA SOIL CONSERVATION SERVICE (SCS) OR A REGISTERED AGRICULTURAL ENGINEER CONSULTANT. THE SCS SHALL BE ENCOURAGED TO AUGMENT ITS STAFF BY REASSIGNING PERSONNEL, IF NECES-SARY, TO MEET THE DEMAND FOR CONSERVATION PLANS.
4. CONSERVATION PLANS TO BE PREPARED FOR BMP IMPLEMENTATION ARE TO BE BASED UPON THE PRIORITY SYSTEM DEVELOPED FROM THE SCS "SOIL EROSION HAZARD MAP" AND/OR SCS STAFF DETERMINATION OF CURRENT LAND USE. THOSE AREAS WITH HIGH EROSION HAZARD DESIGNATION SHOULD RECEIVE TOP PRIORITY FOR THE PREPARATION OF CONSERVATION PLANS AND THE IMPLEMENTATION OF BMPs. THE COUNTY/CITY SHOULD ATTEMPT TO HAVE PLANS FOR HIGH EROSION AREAS PREPARED AS SOON AS POSSIBLE AND NO LATER THAN APRIL 1983, AND VOLUN-TARY IMPLEMENTATION BY NOVEMBER 1983.
5. CONSERVATION PLANS FOR OTHER EROSION AREAS SHOULD BE PREPARED BY NOVEMBER 1984, WITH THE IMPLEMENTATION, BY NOVEMBER 1985, OF BMPs THAT THE SCS HAS DETERMINED TO BE MINIMALLY NECESSARY FOR THE PROPER MANAGE-MENT OF THE GIVEN LAND USE.
6. THE COUNTY/CITY SHOULD ENCOURAGE IMPLEMENTATION IN ALL AREAS BY NOVEMBER 1987, OF BMP ALTERNATIVES WHICH MAY BE ESSENTIAL OR DESIRABLE BUT WHICH MUST BE DETERMINED ON A SITE-SPECIFIC BASIS.
7. THE COUNTY/CITY SHALL MONITOR THE PROGRESS OF CONSERVATION PLAN PREPARA-TION AND BMP IMPLEMENTATION AND REPORT TO THE SANTA ANA REGIONAL WATER QUALITY CONTROL BOARD (SARWQCB). THE PROGRESS REPORTS SHOULD LIST PLANS THAT HAVE BEEN PREPARED DURING THE PERIOD AND THE AGRICULTURAL LAND USER'S SELF-ESTABLISHED TIME SCHEDULE FOR BMP IMPLEMENTATION (BUT NO LATER THAN THE DATES SET IN THE ORDINANCE). THE REPORT SHOULD ALSO IN-CLUDE THE PERCENTAGES OF EACH EROSION HAZARD AREA THAT HAVE HAD CONSERVA-TION PLANS PREPARED AND AN UPDATE OF THE IMPLEMENTATION OF BMPs FOR EACH PREPARED CONSERVATION PLAN. THE PROPOSED SCOPE, LEVEL OF DETAIL, AND FREQUENCY OF THE REPORTS WILL BE DEVELOPED BY THE COUNTY/CITIES AND APPROVED BY THE SARWQCB WITHIN 90 DAYS OF CERTIFICATION OF THIS AMENDMENT. THE COMPLETED CONSERVATION PLANS WILL BE SUBJECT TO APPROVAL BY THE CITY/COUNTY, WITH CRITERIA FOR APPROVAL TO BE DRAFTED BY THE ORANGE COUNTY RESOURCE CONSERVATION DISTRICT AND REVIEWED BY CONCERNED AGENCIES.
8. AGRICULTURAL LAND USERS WILL BE ENCOURAGED TO PARTICIPATE IN ALL AVAILABLE EDUCATIONAL, FINANCIAL, AND TECHNICAL ASSISTANCE PROGRAMS

FOR THE DEVELOPMENT OF BMPs, ESPECIALLY THOSE OFFERED BY THE SECRETARY OF AGRICULTURE UNDER THE AGRICULTURAL CONSERVATION PROGRAM.

9. THE COUNTY/CITY, CONSISTENT WITH ITS PRIMARY RESPONSIBILITY FOR LAND USE PRACTICES WITHIN ITS JURISDICTIONAL BOUNDARIES, SHALL TAKE APPROPRIATE ACTION TO STRENGTHEN ITS MANAGEMENT CONTROL STRATEGY FOR SEDIMENTATION FROM AGRICULTURAL ACTIVITIES, SHOULD THE COUNTY/CITY AND THE SARWQCB DEEM THAT THE PROPOSED VOLUNTARY IMPLEMENTATION IS INEFFECTIVE.
10. THE CSWRCB SHALL WITHDRAW ITS DESIGNATION OF THE COUNTY/CITY AS A MANAGEMENT AGENCY IF, IN ITS OPINION, THE COUNTY/CITY IS NOT SUCCESSFUL IN IMPLEMENTING AN EFFECTIVE AGRICULTURAL SEDIMENTATION CONTROL STRATEGY.
11. SHOULD THE CSWRCB DETERMINE THAT IT WILL WITHDRAW ITS DESIGNATION OF THE COUNTY/CITY, THE SARWQCB MAY, BASED ON ITS EXISTING AUTHORITIES UNDER THE PORTER-COLOGNE ACT, CHOOSE TO ESTABLISH LIMITATIONS ON THE AMOUNT OF SEDIMENT DISCHARGED FROM SPECIFIC WATER CONVEYANCE STRUCTURES TO THE WATERS OF THE STATE.





RESOLUTION OF THE BOARD OF SUPERVISORS OF

ORANGE COUNTY, CALIFORNIA

April 12, 1983

On motion of Supervisor Harriett M. Wieder, duly seconded and carried, the following Resolution was adopted:

WHEREAS, the primary objective of Public Law 92-500, commonly referred to as the Clean Water Act, is the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters; and

WHEREAS, Upper Newport Bay has been identified as a critical water-quality problem area in the South Coast area; and

WHEREAS, a specific element of the SCAG 208 Plan was developed to address components of this problem; and

WHEREAS, sedimentation in Upper Newport Bay has been identified as a major component of the water-quality problem, with sedimentation from agricultural activities being recognized as a specific area of concern; and

WHEREAS, by Resolution 79-363, the Orange County Board of Supervisors has made a commitment to assist in the development of agricultural Best Management Practices (BMP's) in the Newport Bay Watershed and to encourage their implementation; and

WHEREAS, SCAG has amended the 208 Areawide Waste Treatment Management Plan to include an agricultural sedimentation control program for the Upper Newport Bay Watershed; and

WHEREAS, the State Water Quality Control Board has certified the amended 208 Plan; and

WHEREAS, the County has informally implemented the actions specified in the agricultural sedimentation control program in cooperation with The Irvine Company, the predominant landowner in the Upper Newport Bay Watershed; and

WHEREAS, by Resolution 83-422, the Orange County Board of Supervisors described their intent to formally implement an agricultural sedimentation control program;

NOW, THEREFORE, BE IT RESOLVED that the County of Orange commits to implement the actions described in the agricultural sedimentation control plan in accordance with the following directives to EMA:

1. To work with agricultural landowners in the unincorporated territory of the San Diego Creek Watershed on the preparation of Resource Conservation Plans (RCP's), with the landowners responsible for preparation of the RCP's through the services of the USDA Soil Conservation Service (SCS) or a registered agricultural engineer.
2. To require that the RCP's follow guidelines approved for the Newport Bay agricultural sedimentation control program.
3. To request the SCS to augment its staff in Orange County by reassigning personnel, if necessary, to meet the demand for RCP's.
4. To work with landowners to ensure that RCP's are prepared on a priority system developed from the SCS "Soil Erosion Hazard Map" and/or SCS staff determination of current land use. Those areas with high erosion hazard designation should receive top priority for the preparation of RCP's. EMA should then ensure that landowners implement the plans for the high erosion areas by November, 1983.
5. To work with landowners to ensure that RCP's for other

erosion areas are prepared by November, 1984 with the implementation by November, 1985 of BMP's that the SCS has determined to be minimally necessary for the proper management of the given land use.

6. To encourage implementation in all areas by November, 1987 of BMP alternatives which may be essential or desirable but which must be determined on a site-specific basis.

7. To monitor the progress of RCP preparation and BMP implementation and submit reports on that progress and the effectiveness of the BMP's to the Santa Ana Regional Water Quality Control Board (SARWQCB). The progress reports should list RCP's that have been prepared during the period and the agricultural landowner's self-established time schedule for BMP implementation (but no later than the dates specified in action No's 3 and 4). The report should also include the percentages of each erosion hazard area that have had RCP's prepared and an update of the implementation of BMP's for each prepared RCP. The proposed scope, level of detail, and frequency of the reports shall be developed by EMA and the SARWQCB within 90 days of adoption of this resolution.

8. To encourage agricultural landowners to participate in all available educational, financial, and technical assistance programs for the development of BMP's, especially those offered by the Secretary of Agriculture under the Agricultural Conservation Program.

9. To report back to the Board of Supervisors with specific recommendations if the agricultural sedimentation control program specified herein fails to meet schedules or comply with approved guidelines. The recommendations shall include consideration of (a) adoption of an ordinance requiring a program and


(b) the feasibility of establishing discharge requirements  
by the SARWQCB as authorized in the Porter-Cologne Act.

AYES:           SUPERVISORS   HARRIETT M. WIEDER, THOMAS F. RILEY, BRUCE  
  NESTANDE, RALPH B. CLARK, ROGER R. STANTON  
NOES:           SUPERVISORS   NONE  
ABSENT:         SUPERVISORS   NONE

STATE OF CALIFORNIA   )  
  )   ss.  
COUNTY OF ORANGE     )

I, JUNE ALEXANDER, Clerk of the Board of Supervisors of Orange County, California hereby certify that the above and foregoing Resolution was duly and regularly adopted by the said Board at a regular meeting thereof held on the 12th day of April, 19 83, and passed by a unanimous vote of said Board.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 12th day of April, 19 83.

  
JUNE ALEXANDER  
Clerk of the Board of Supervisors of  
Orange County



CITY COUNCIL RESOLUTION NO. 81-113

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF IRVINE APPROVING IN CONCEPT THE IMPLEMENTATION AND ENFORCEMENT OF THOSE ELEMENTS OF THE SOUTH COAST AREAWIDE WASTE TREATMENTS MANAGEMENT PLAN APPROPRIATE TO THE CITY OF IRVINE

WHEREAS, The Federal Water Pollution Control Act (33. U.S.C. 1251, et., seq., as amended) seeks to develop a cooperative Federal, State, regional and local government program to prevent and control sources of pollution to ground and surface waters in order to restore and maintain the chemical, physical and biological integrity of the Nation's water; and

WHEREAS, pursuant to Section 208 of the Federal Water Pollution Control Action of 1972, as amended, the Southern California Association of Governments (herein referred to as SCAG) has adopted an Areawide Water Treatment Management Plan for the South Coast area with the assistance of the Counties of Los Angeles, Orange, Riverside, and San Bernardino, the City of Los Angeles, the Newport-Irvine Waste-Management Planning Agency, the Santa Ana Watershed Project Authority and the Ventura Regional County Sanitation Districts; and

WHEREAS, the Areawide Waste Treatment Plan for the South Coast area was adopted by SCAG on April 5, 1979 and certified by the State Water Resources Control Board on July 19, 1979, and approved by the Federal Environmental Protection Agency on March 21, 1980, in compliance with Section 208(b)(3) of the Federal Water Pollution Control Act of 1972, as amended; and

WHEREAS, 208 continuing planning included development of an Agricultural Activities Interim Sediment Control Plan (BMP) and a Construction Activities Best Management Practices Plan for sediment control for the Newport Bay Watershed; and

WHEREAS, draft interim 208 Plan amendments, dated October 1981, were developed based on recommendations from said Sedimentation Control Plan; and

WHEREAS, the State Water Resources Control Board, the designated administrator of the 208 Program in the State of California, has approved said plan; and

WHEREAS, SCAG's Overall Work Program includes provision for obtaining implementation commitments from affected and affecting agencies; and

WHEREAS, the Areawide Waste Treatment Management Plan for the South Coast area proposes management agencies to be responsible for plan implementation and pursuant to published United States Environmental Protection Agency guidelines (42 Fed. Reg. 44777, 1977 ) must indicate each management agency's willingness and authority to proceed to carry out its responsibilities as identified in the Plan; and

WHEREAS, the City of Irvine has primary responsibility for land use practices within its jurisdictional boundaries and has made a commitment to alleviate the sedimentation problem in Newport Bay; and

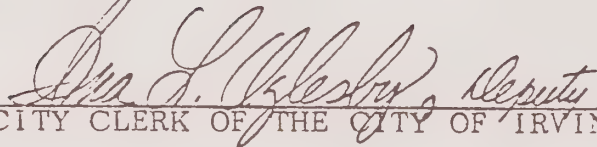
WHEREAS, the application of agricultural Best Management Practices and of construction Best Management Practices (BMPs) are effective methods of sedimentation control.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Irvine approves in concept the development and adoption of an ordinance implementing and enforcing the elements of the SCAG South Coast Areawide Waste Treatment Management Plan that are appropriate to the City of Irvine.

PASSED AND ADOPTED by the City Council of the City of Irvine at a regular meeting held on 24th day of November, 1981.

  
\_\_\_\_\_  
DAVID G. SILLS  
MAYOR OF THE CITY OF IRVINE

ATTEST:

  
\_\_\_\_\_  
CITY CLERK OF THE CITY OF IRVINE

STATE OF CALIFORNIA )  
COUNTY OF ORANGE ) SS  
CITY OF IRVINE )

I, NANCY C. ROWLAND, City Clerk of the City of Irvine, HEREBY DO CERTIFY that the foregoing Resolution was duly adopted at a regular meeting of the City Council of the City of Irvine, held on the 24th day of November, 1981, by the following roll call vote:

AYES:	5	COUNCILMEMBERS:	Agran, Anthony, Gaido, Vardoulis and Sills
NOES:	0	COUNCILMEMBERS:	None
ABSENT:	0	COUNCILMEMBERS:	None

  
\_\_\_\_\_  
CITY CLERK OF THE CITY OF IRVINE

A RESOLUTION OF THE CITY COUNCIL OF THE CITY  
OF NEWPORT BEACH SUPPORTING THE IMPLEMENTATION  
OF AN AGRICULTURAL ACTIVITIES SEDIMENTATION  
CONTROL PLAN FOR UPPER NEWPORT BAY WATERSHED

WHEREAS, Upper Newport Bay Ecological Reserve is a valuable regional resource, providing habitat for three rare and endangered bird species; and

WHEREAS, extensive sedimentation is taking place in the Upper Newport Bay, degrading the quality of the resource; and

WHEREAS, the City of Newport Beach has long been committed to efforts to preserve the Upper Newport Bay; and

WHEREAS, the Federal Water Pollution Control Act (33. U.S.C. 1251, et seq, as amended) seeks to develop a cooperative Federal, State, regional and local government program to prevent and control sources of pollution to ground and surface waters in order to restore and maintain the chemical, physical and biological integrity of the nation's waters; and

WHEREAS, pursuant to Section 208 of the Federal Water Pollution Control Act of 1972, as amended, the Southern California Association of Governments (herein referred to as SCAG) has adopted an Areawide Water Treatment Management Plan for the South Coast area with the assistance of the counties of Los Angeles, Orange, Riverside and San Bernardino, the City of Los Angeles, the Newport-Irvine Waste-Management Planning Agency, the Santa Ana Watershed Project Authority and the Ventura Regional County Sanitation Districts; and

WHEREAS, 208 continuing planning included development of an Agricultural Activities Interim Sediment Control Plan for the Newport Bay Watershed; and

WHEREAS, an interim 208 Plan amendment dated October, 1981 was developed based on recommendations from said Sedimentation Control Plan; and

WHEREAS, the State Water Resources Control Board, the designated administrator of the 208 Program in the State of California, has approved said plan; and

WHEREAS, the application of agricultural Best Management Practices (BMPs) is an effective method of sedimentation control.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Newport Beach that the City of Newport Beach supports the "Newport Bay Watershed: Agricultural Activities Sedimentation Control Plan" and urges other agencies within the watershed, consistent with their responsibilities for land use practices within their respective boundaries, to take appropriate action to strengthen their management control strategies for sedimentation from agricultural activities.

ADOPTED this \_\_\_\_ day of NOV 9, 1981.

\_\_\_\_\_  
Mayor

ATTEST:

\_\_\_\_\_  
City Clerk



## BEST MANAGEMENT PRACTICES (BMPs) FOR AGRICULTURAL LANDS

Attached are descriptions of first and second phase resources management sub-systems/BMPs and the component conservation practices recommended by the SCS to the land users, specific for each of the agricultural land uses in the Newport Bay Watershed including:

1. Citrus
2. Avocados
3. Cropland
4. Rangeland
5. Irrigated Pasture

Best management practices for agricultural lands are divided into two categories: first phase BMPs are those practices minimally necessary for proper management with a given land use; and second phase BMPs are those that are essential or desirable but must be determined on a site-specific basis with consideration of special problems including economic factors.

The first phase measures generally include crop residue use, conservation cropping for soil conservation and erosion control, and irrigation water management. For orchards on the steeper slopes, contour planting, terraces, planned access roads, and stabilized waterways are included.

The first priority for measures to be installed on agricultural lands includes those which will be most effective in reducing sediment production under winter conditions. These measures are primarily first phase measures that are considered normally sound agricultural practices: crop residue use, cover and green manure crops, conservation cropping for soil conservation and erosion control on all lands; and contour planting, terraces, planned access roads and stabilized waterways on the steeper slopes. First priority measures would also include obtaining solutions to the problem areas specified in the OCEMA report.

The second priority measures are generally those which require site-specific determinations and evaluations. They include channel stabilization measures, streambank protection, diversions, grassed waterways, improved irrigation water management, and range management.

## CITRUS - FIRST PHASE RECOMMENDED BMP's

### EROSION CONTROL SUB-SYSTEM/BMP

Crop Residue Use - Plant residues will be used to protect orchards during critical erosion periods, to conserve soil moisture, increase soil infiltration, reduce soil loss, and improve soil tilth.

Cover and Green Manure Crop - Close-growing grasses, legumes or small grain will be grown for seasonal protection and soil improvement, to control erosion, and improve infiltration, aeration and tilth.

Access Road - A travelway will be constructed to provide access for equipment operation and management of conservation enterprises.

### WATER MANAGEMENT SUB-SYSTEM/BMP

Irrigation Water Management - Water application will be done efficiently by controlling the rate, amount and timing of irrigation to promote desired crop response, minimize soil erosion and loss of plant nutrients, control water loss, and protect water quality.

Irrigation System, Drip - An irrigation system will be designed to efficiently apply irrigation water directly to the plant root zone to maintain soil moisture within the range for good plant growth and without excessive water loss, erosion, reduction in water quality, or salt accumulation.

### SOIL MANAGEMENT SUB-SYSTEM

Conservation Cropping System - A combination of needed cultural and management measures will be used to improve or maintain good physical condition of the soil, protect the soil during periods when erosion occurs, help control weeds, insects, and diseases, and ensure an economic return.

Cover and Green Manure Crop - Close-growing grasses, legumes or small grain will be grown for seasonal protection and soil improvement, to control erosion, and improve infiltration, aeration and tilth.

Crop Residue Use - Plant residues will be used to protect orchards during critical erosion periods, to conserve soil moisture, increase soil infiltration, reduce soil loss, and improve soil tilth.

CITRUS - SECOND PHASE RECOMMENDED BMP'S

ALTERNATIVES\*:

Erosion Control Sub-system

- Debris Basins
- Diversion
- Field Windbreak
- Filterstrip
- Grade Stabilization Structure
- Mulching
- Stream Channel Stabilization
- Streambank Protection
- Terraces
- Contour Farming

Excess Water Removal Sub-system

- Surface Drainage
- Subsurface Drainage

Irrigation Sub-system

- Irrigation Regulating Reservoir
- Pumping Plant for Water Control
- Irrigation Tailwater Recovery

Soil Management Sub-system

- Chiseling and Subsoiling
- Toxic Salt Reduction

Water Development Sub-system

- Well
- Wildlife Watering Facility

Wildlife Management Sub-system

- Wildlife Upland Habitat Management
  - Brush Management
  - Field Border

\*Conservation practice may be essential or desirable after a site investigation.



## AVOCADOS - FIRST PHASE RECOMMENDED BMP's

### EROSION CONTROL SUB-SYSTEM/BMP

Terraces - These will be constructed on the contour and graded with a 2-3% slope to the outside. This will provide good access and reduce collection of runoff water and minimize soil erosion.

Access Road - A road will be constructed to enable vehicular access to orchard. See irrigation design for locations.

Critical Area Planting - An annual grass will be seeded on access roads and disturbed areas to minimize erosion and runoff to the downstream areas.

Contour Orchards - The farming operations will be conducted in such a way that land preparation, planting and cultivation are done on the contour to reduce soil and water losses.

Grassed Waterways - A hybrid bermuda grass sod will be planted and maintained in waterways to prevent soil loss and formation of gullies.

Cover Crop - Native grasses will be established between tree rows and maintained by mowing.

### SOIL MANAGEMENT SUB-SYSTEM/BMP

Minimum Tillage - The number of equipment operations each year will be limited to those that are properly timed and essential to produce a crop and prevent soil damage.

Cover Crop - Native grasses will be established between tree rows and maintained by mowing.

### WATER MANAGEMENT SUB-SYSTEM/BMP

Irrigation Water Management - The amount of water to be applied will

be according to the plant needs and water holding capacities of the soils. The rate and timing of the applications will be according to an irrigation guide and tensiometer readings. To prevent the accumulation of excessive salts in the soil and maintain a soil solution favorable to good avocado growth, an additional 30% water should be applied two or three times a year over and above irrigation requirements where Colorado River water is used. In some years rainfall may do the required leaching and other years only part of the required leaching. Periodic checks of soil salinity will be made to determine the level of accumulated salts in the soil.

Irrigation System, Drip - An irrigation system will be installed for the efficient application of water directly to the root zone of plants by means of emitters.

#### IRRIGATION SUB-SYSTEM/BMP

Irrigation Water Conveyance, High Pressure Underground Plastic - Mains and laterals will be installed to convey water from filters to emitters with minimum friction loss.

AVOCADOS - SECOND PHASE RECOMMENDED BMP's

ALTERNATIVES\*:

Erosion Control Sub-system

- Debris Basins
- Diversion
- Field Windbreak
- Filterstrip
- Grade Stabilization Structure
- Mulching
- Stream Channel Stabilization
- Streambank Protection

Excess Water Removal Sub-system

- Surface Drainage
- Subsurface Drainage

Irrigation Sub-system

- Irrigation Regulating Reservoir
- Pumping Plant for Water Control

Soil Management Sub-system

- Chiseling and Subsoiling
- Toxic Salt Reduction

Water Development Sub-system

- Well
- Wildlife Watering Facility

Wildlife Management Sub-system

- Wildlife Upland Habitat Management
- Brush Management
- Field Border

\*Conservation practice may be essential or desirable after a site investigation.

## CROPLAND - FIRST PHASE RECOMMENDED BMP's

### EROSION CONTROL SUB-SYSTEM/BMP

Crop Residue Use - Plant residues will be used to protect crops during critical erosion periods, to conserve soil moisture, increase infiltration, reduce soil loss, and improve soil tilth.

### SOIL MANAGEMENT SUB-SYSTEM/BMP

Conservation Cropping System - A combination of needed cultural and management measures will be used to improve or maintain good physical condition of the soil, protect the soil during periods when erosion occurs, help control weeds, insects and diseases, and ensure an economic return.

Crop Residue Use - Plant residues will be used to protect crops during critical erosion periods, to conserve soil moisture, increase infiltration, reduce soil loss, and improve soil tilth.

### WATER MANAGEMENT SUB-SYSTEM/BMP

Irrigation System, Drip or Sprinkler - An irrigation system will be designed to efficiently apply water by means of emitters or pipes and nozzles under pressure to maintain soil moisture within the range for good plant growth and without excessive water loss, erosion, reduction in water quality, or salt accumulation.

Irrigation Water Management - Water application will be done efficiently by controlling the rate, amount and timing of irrigation to promote desired crop response, minimize soil erosion and loss of plant nutrients control water loss, and protect water quality.



## IRRIGATION SUB-SYSTEM/BMP

Irrigation Water Conveyance - Mains and laterals will be designed using high pressure, underground, plastic pipeline to minimize friction loss from the meter to sprinkler heads.

CROPLAND - SECOND PHASE RECOMMENDED BMP's

ALTERNATIVES\*:

Erosion Control Sub-system

- Access Road
- Contour Farming
- Debris Basins
- Diversion
- Floodwater Diversion
- Filterstrip
- Grade Stabilization Structure
- Grassed Waterway
- Stream Channel Stabilization
- Streambank Protection
- Terraces

Excess Water Removal Sub-system

- Land Smoothing
- Surface Drainage
- Subsurface Drainage

Irrigation Sub-system

- Irrigation Land Leveling
- Irrigation Regulating Reservoir
- Irrigation Tailwater Recovery
- Structure for Water Control
- Pumping Plant for Water Control

Soil Management Sub-system

- Chiseling and Subsoiling
- Toxic Salt Reduction

Water Development Sub-system

- Well
- Wildlife Water Facility

Wildlife Management Sub-system

- Wildlife Wetland Habitat Management
- Wildlife Upland Habitat Management
- Field Border
- Hedgerow Planting

\*Conservation practice may be essential or desirable after a site investigation.

## RANGELAND - FIRST PHASE RECOMMENDED BMP's

### RANGE MANAGEMENT SYSTEM/BMP

Brush Management - Management of brush on rangeland will be done by mechanical, chemical or biological means to improve or restore a quality plant cover, reduce sediment and improve water quality, increase quality and production of desirable plants for livestock and wildlife, maintain or increase wildlife habitat values, enhance aesthetic and recreation qualities, maintain open land, and protect life and property.

Range Seeding - Adapted plants will be established by seeding to prevent excessive soil and water loss and improve water quality, produce more forage for grazing animals, and improve the visual quality of grazing land.

Proper Grazing Use - Grazing will be done at an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation.

Planned Grazing System - A grazing system will be used in a planned sequence where grazing units are alternately grazed and rested to maintain existing plant cover or hasten its improvement, to reduce erosion and improve water quality, to increase efficiency by uniformly using all parts of each grazing unit, to ensure a supply of forage throughout the grazing season, and to increase production and improve quality of forage.

Fencing - The area will be enclosed or divided by fences to subdivide grazing land to permit use of a grazing system, protect new seedings and plantings from grazing, and to regulate access to areas.

RANGELAND - SECOND PHASE RECOMMENDED BMP's

ALTERNATIVES\*:

Range Management Sub-system

- Access Roads
- Deferred Grazing
- Firebreak
- Prescribed Burning
- Salting
- Stock Trails

Water Development Sub-system

- Pond
- Spring Development
- Trough or Tank
- Well
- Wildlife Water Facility

Wildlife Management Sub-system

- Wildlife Upland Habitat Management
- Field Border

\*Conservation practices may be essential or desirable after a site investigation.



## IRRIGATED PASTURE - FIRST PHASE RECOMMENDED BMP's

### PASTURE MANAGEMENT SUB-SYSTEM/BMP

Fencing - This will be constructed to control livestock (horses, cows, sheep), subdivide grazing unit and regulate access to areas.

Pasture Planting - Long term stands of adapted species of grasses and legumes will be seeded to reduce erosion and produce high quality forage. Refer to irrigated pasture guidelines.

Pasture Management - A grazing system will be used to maintain or improve the quality and quantity of forage. Refer to irrigated pasture guidelines.

### WATER MANAGEMENT SUB-SYSTEM/BMP

Irrigation System, Sprinkler - An irrigation system will be designed to provide efficient and uniform water distribution and reduce excessive water loss and erosion.

Irrigation Water Management - Water application will be done efficiently by controlling the rate, amount and timing of irrigation. Refer to irrigation guidelines.

### IRRIGATION SUB-SYSTEM/BMP

Irrigation Water Conveyance - Mains and laterals will be designed using high pressure, underground, plastic pipeline to minimize friction loss from the meter to sprinkler heads.

IRRIGATED PASTURE - SECOND PHASE RECOMMENDED BMP's

ALTERNATIVES\*:

Erosion Control Sub-system

- Field Windbreak
- Heavy Use Area Protection
- Hillside Ditch

Irrigation Sub-system

- Pumping Plant for Water Control

Soil Management Sub-system

- Mulching
- Toxic Salt Reduction

Watering Development Sub-system

- Trough or Tank
- Well
- Wildlife Watering Facility

Wildlife Management Sub-system

- Hedgerow Planting

\*Conservation practice may be essential or desirable after a site investigation.

U.C. BERKELEY LIBRARIES



C124890914

